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FINAL RCRA FACILITY INVESTIGATION FOR PARCEL D AND BACKGROUND STUDY
SAMPLING AND ANALYSIS PLAN NAS FORT WORTH TX
8/1/1996
JACOBS ENGINEERING



**NAVAL AIR STATION
FORT WORTH JRB
CARSWELL FIELD
TEXAS**

**ADMINISTRATIVE RECORD
COVER SHEET**

AR File Number 384



United States Air Force Air Force Base Conversion Agency

FINAL

NAS Fort Worth JRB, Texas
(Formerly Carswell AFB, Texas)

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FOR PARCEL D AND
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SEPTEMBER 1996

By:



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LIST OF ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
AFCEE	Air Force Center for Environmental Excellence
AFIID	Air Force installation identification
A2LA	American Association for Laboratory Accreditation
ARAR	applicable or relevant and appropriate requirement
ASCII	American Standard Code Information Interchange
ASTM	American Society for Testing and Materials
BFB	bromofluorobenzene
Br	bromide
BTEX	benzene, toluene, ethylbenzene, xylene
°C	degrees Celsius
CCC	calibration check compound
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	calibration factor
CFR	Code of Federal Regulation
Cl	chloride
CL	control limit
CLP	Contract Laboratory Program
COC	chain of custody
2,4-D	2,4-dichlorophenoxy acetic acid
2,4-DB	2,4-dichlorophenoxy butyric acid
DCA	dichloroethane
DCB	dichlorobenzene
DCBP	decachlorobiphenyl
DCE	dichloroethene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane

DEQPPM	Defense Environmental Quality Program Policy Memorandum
DFTPP	decafluorotriphenylphosphine
DNB	dinitrobenzene
DNT	dinitrotoluene
DOD	Department of Defense
DQO	data quality objective
DRO	diesel range organics
EDB	ethylene dibromide
EICP	extracted ion current profile
EPA	Environmental Protection Agency
F⁻	fluoride
FID	flame ionization detector
FLAA	flame atomic absorption
FS	feasibility study
FSP	field sampling plan
g	gram
G	glass
GC	gas chromatography
GC/MS	gas chromatography/mass spectroscopy
GFAA	graphite furnace atomic absorption
GRO	gasoline range organics
Handbook	<i>Handbook for the Installation Restoration Program (IRP) Remedial Investigation and Feasibility Studies (RI/FS)</i> , September 1993
HCl	hydrochloric acid
HECD	(Hall) electrolytic conductivity detector
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HNO₃	nitric acid

HPLC	high-performance liquid chromatography
H₂SO₄	sulfuric acid
IAW	in accordance with
ICP	inductively coupled plasma
ICPES	inductively coupled plasma emission spectroscopy
ICP-MS	inductively coupled plasma - mass spectroscopy
ICS	interference check standard
ID	identification
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
IS	internal standard
LCL	lower control limit
LCS	laboratory control sample
MCPA	(4-chloro-2-methylphenoxy) acetic acid
MCP	2-(4-chloro-2-methylphenoxy) propionic acid
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
mm	millimeter
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
Na₂S₂O₃	sodium thiosulfate
NCP	National Contingency Plan
ng/L	nanograms per liter
ng/mL	nanograms per milliliter
NIST	National Institute of Standards and Technology
nm	nanometer
NO₂⁻	nitrite
NO₃⁻	nitrate

NTU	nephelometric turbidity unit
OCDD	octachlorodibenzo-p-dioxin
ORP	oxidation-reduction potential
OVA	organic vapor analyzer
P	polyethylene
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PE	performance evaluation
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
PID	photoionization detector
PO₄⁻³	phosphate
ppb	parts per billion
ppm	parts per million
ppmv	parts per million volume
PQL	practical quantitation limit
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
R	recovery
RCA	recommendations for corrective action
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RF	response factor
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
RSD	relative standard deviation
S	soil

SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SO₄⁻²	sulfate
SOP	standard operating procedure
SOW	statement of work
SPCC	system performance check compound
SVOC	semivolatile organic compound
2,4,5-T	2,4,5-trichlorophenoxy acetic acid
T	California brass
TCA	trichloroethane
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TCMX	tetrachlorometaxylene
TIC	tentatively identified compound
TNB	trinitrobenzene
TNT	trinitrotoluene
2,4,5-TP	2,4,5-trichlorophenoxy acetic acid (silvex)
TPH	total petroleum hydrocarbon
UCL	upper control limit
VOC	volatile organic compound
v/v	volume to volume
W	water

SYMBOLS

mg/kg	micrograms per kilogram
mg/L	micrograms per liter
mg/mL	micrograms per milliliter
mL	microliter
mm	micrometer

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1.0 INTRODUCTION

The Quality Assurance Project Plan (QAPP) presents in specific terms the policies, organization, functions, and Quality Assurance/Quality Control (QA/QC) requirements designed to achieve the data quality goals described in the approved Sampling and Analysis Plan (SAP) for the project. This detailed QAPP, (1) has been prepared for use by contractors who perform environmental services to ensure the data are scientifically valid and defensible, and (2) establishes the analytical protocols and documentation requirements to ensure the data are collected, reviewed, and analyzed in a consistent manner. This QAPP and a site specific Field Sampling Plan (FSP) shall constitute, by definition, an AFCEE Sampling and Analysis Plan (SAP).

The National Contingency Plan (NCP) specifies circumstances under which a QAPP is necessary for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions. For cleanup actions at the remedial investigation/feasibility study (RI/FS) stage, the NCP requires lead agents to develop sampling and analysis plans which provide a process for obtaining data of sufficient quality and quantity to satisfy data needs. Such sampling and analysis plans must include a quality assurance project plan "which describes policy, organization, and functional activities and the data quality objectives and measures necessary to achieve adequate data for use in selecting the appropriate remedy." 40 CFR 300.430 (b)(8)(ii).

The U.S. Environmental Protection Agency (EPA) QA policy requires a QAPP for every monitoring and measurement project mandated or supported by the EPA through regulations, contracts, or other formalized means not currently covered by regulation. Guidelines followed in the preparation of this plan are set out in *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (U.S. EPA, 1983a) and *U.S. EPA Region IX QAPP: Guidance for Preparing QAPPs for Superfund Remedial Projects* (U.S. EPA, 1989). Other documents that have been referenced for this plan include *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final* (U.S. EPA, 1988); *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, Draft Final, EPA QA/R-5* (U.S. EPA, 1993), *Compendium of Superfund Field Operations Methods* (U.S. EPA, 1987a); *Data Quality Objectives Process for Superfund, Interim Final Guidance* (U.S. EPA, 1993); *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (U.S. EPA, 1994), *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (U.S. EPA, 1994), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (U.S. EPA SW-846, Third Edition and its first and second update), and the *Handbook for Installation Restoration Program (IRP)*

Remedial Investigations and Feasibility Studies (RI/FS) (Handbook), September 1993.

This QAPP is required reading for all staff participating in the work effort. The QAPP shall be in the possession of the field teams and in the laboratories performing all analytical methods. All contractors and subcontractors shall be required to comply with the procedures documented in this QAPP in order to maintain comparability and representativeness of the data produced.

Controlled distribution of the QAPP shall be implemented by the prime contractor to ensure the current version is being used. A sequential numbering system shall be used to identify controlled copies of the QAPP. Controlled copies shall be provided to applicable Air Force managers, regulatory agencies, remedial project managers, project managers, and QA coordinators. Whenever Air Force revisions are made or addenda added to the QAPP, a document control system shall be put into place to assure (1) all parties holding a controlled copy of the QAPP shall receive the revisions/addenda and (2) outdated material is removed from circulation. The document control system does not preclude making and using copies of the QAPP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations. The distribution list for controlled copies shall be maintained by the prime contractor.

2.0 PROJECT DESCRIPTION

2.1 THE U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM

The objective of the U.S. Air Force Installation Restoration Project (IRP) is to assess past hazardous waste disposal and spill sites at U.S. Air Force installations and to develop remedial actions consistent with the NCP for sites that pose a threat to human health and welfare or the environment. This section presents information on the program origins, objectives, and organization.

The 1976 Resource Conservation Recovery Act (RCRA) is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require federal agencies to comply with local and state environmental regulations and provide information to the EPA concerning past disposal practices at federal sites. RCRA Section 3012 requires state agencies to inventory past hazardous waste disposal sites and provide information to the EPA concerning those sites.

In 1980, Congress enacted CERCLA (Superfund). CERCLA outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. The CERCLA legislation identifies the EPA as the primary policy and enforcement agency regarding contaminated sites.

The 1986 Superfund Amendments and Reauthorization Act (SARA) extends the requirements of CERCLA and modifies CERCLA with respect to goals for remediation and the steps that lead to the selection of a remedial process. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends the EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and the consideration of potential remediation alternatives is recommended at the initiation of an RI/FS. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DOD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when they are the sole or co-contributor to contamination on or off their properties.

To ensure compliance with CERCLA, its regulations, and Executive Order 12580, the DOD developed the IRP, under the Defense Environmental Restoration Program, to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated facilities. The DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the

IRP program in June 1980, and implemented the policies outlined in this memorandum in December 1980. The NCP was issued by EPA in 1980 to provide guidance on a process by which (1) contaminant release could be reported, (2) contamination could be identified and quantified, and (3) remedial actions could be selected. The NCP describes the responsibility of federal and state governments and those responsible for contaminant releases.

The DOD formally revised and expanded the existing IRP directives and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated 11 December 1981. The memorandum was implemented by a U.S. Air Force message dated 21 January 1982.

The IRP is the DOD's primary mechanism for response actions on U.S. Air Force installations affected by the provisions of SARA. In November 1986, in response to SARA and other EPA interim guidance, the U.S. Air Force modified the IRP to provide for an RI/FS program. The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than serial activities. The program now includes ARAR determinations, identification and screening of technologies, and development of alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DOD compliance with federal laws, such as RCRA, NCP, CERCLA, and SARA, can be met.

2.2 PURPOSE AND SCOPE

The purpose, scope, and use of this work effort shall be briefly discussed in Section 2.2 of the FSP.

2.3 PROJECT BACKGROUND

A project background description, including (1) the locations of sites at the base or facility, (2) a summary of the contamination history at each site and (3) the findings from previous investigations shall be included in Section 2.3 and Section 2.4 of the FSP.

2.4 PROJECT SCOPE AND OBJECTIVES

A summary of the objectives and the proposed work for each site shall be included in Section 3.1, Section 3.2 and Section 3.3 of the FSP. The intended use of the data acquired during this project, the data quality objective process and a discussion of how the process specific decision rules were derived shall also be described in Section 3.1 of the FSP.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The project organization and responsibility discussion including (1) a project organizational chart identifying task managers and individuals responsible for performance of the project, (2) a list of names of all key participants, including organization names and telephone numbers for project, field, and laboratory QA officers, (3) a description of the authority given to each key participant with an emphasis on the authority of the key individuals to initiate and approve corrective actions, and (4) the role of regulatory representatives shall be included in Section 4.0 of the FSP.

All contractors and subcontractors shall be identified and the scope of their performance in the project shall be clearly defined. Subcontractors proposed to provide backup services shall be identified. An organizational chart, a list of key personnel, and the previously described descriptive text shall be included for each subcontractor in Section 4.1 of the FSP.

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4.0 QUALITY PROGRAM AND DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) specify the data type, quality, quantity, and uses needed to make decisions and are the basis for designing data collection activities. The DQOs for the project are specified in the FSP in Section 3.1.

4.1 DATA CATEGORIES

The two general categories of data used by the Air Force Center for Environmental Excellence (AFCEE) are defined as: (1) screening data and (2) definitive data.

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements than are necessary to produce definitive data. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Physical test methods, e.g., dissolved oxygen measurements, temperature and pH measurements, moisture content, turbidity, conductance, etc., have been designated by definition as screening methods (see Section 6).

Screening methods shall be confirmed, as required in Section 3.2 of the FSP, by analyses that generate definitive data. Confirmation samples shall be selected to include both detected and nondetected results from the screening method.

Definitive data are generated using rigorous analytical methods (see Section 7), such as approved EPA reference methods. The data can be generated in a mobile or off-site laboratory. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements (Sections 7 and 8). Definitive data are not restricted in their use unless quality problems require data qualification.

4.2 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

The basis for assessing each of these elements of data quality is discussed in the following subsections. Precision and accuracy QC limits for each method and matrix are identified in Sections 6 and 7.

4.2.1 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of

repeated application of the same process under similar conditions. *Analytical* precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. AFCEE uses the laboratory control sample (LCS) to determine the precision of the analytical method. If the recoveries of analytes in the LCS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches. *Total* precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. The formula for the calculation of precision is provided in Table 4.2.1-1 as RPD. For replicate analyses, the relative standard deviation (RSD) is determined. The formula for the calculation of RSD is provided in Table 4.2.1-1.

4.2.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. Analysis of performance evaluation (PE) samples shall also be used to provide additional information for assessing the accuracy of the analytical data being produced.

Both accuracy and precision are calculated for each AFCEE analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy is included in Table 4.2.1-1 as percent recovery (%R) from pure and sample matrices.

4.2.3 Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation

procedures, and sampling locations. Decisions regarding sample/well/boring locations and numbers and the statistical sampling design are documented in Section 3.3 of the FSP.

4.2.4 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag (see Section 8 for an explanation of flagging criteria). The requirement for completeness is 95 percent for aqueous samples and 90 percent for soil samples. For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

The formula for calculation of completeness is presented below:

$$\% \text{ completeness} = \frac{\text{number of valid (i.e., non-R flagged) results}}{\text{number of possible results}}$$

4.2.5 Comparability

Comparability is the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Analysis of performance evaluation (PE) samples and reports from audits shall also be used to provide additional information for assessing the comparability of analytical data produced among subcontracting laboratories. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

Table 4.2.1-1 Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	\bar{X}	$\frac{\sum_{i=1}^n x_i}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\frac{\sum (x_i - \bar{X})^2}{(n-1)} \right)^{1/2}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S / \bar{X}) \times 100$	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Percent Difference	%D	$\frac{x_1 - x_2}{x_1} \times 100$	Measure of the difference of 2 observations	Used to assess accuracy
Relative Percent Difference	RPD	$\left(\frac{(X_1 - X_2)}{(X_1 + X_2)/2} \right) \times 100$	Measure of variability that adjusts for the magnitude of observations	Used to assess total and analytical precision of duplicate measurements
Percent Recovery	%R	$\left(\frac{X_{\text{meas}}}{X_{\text{true}}} \right) \times 100$	Recovery of spiked compound in pure matrix	Used to assess accuracy
Percent Recovery	%R	$\frac{\left(\begin{array}{cc} \text{value of} & \text{value of} \\ \text{spiked} & - \text{unspiked} \\ \text{sample} & \text{sample} \end{array} \right)}{\text{Value of added spike}} \times 100$	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision

x = Observation (concentration)
n = Number of observations

4.3 METHOD DETECTION LIMITS, PRACTICAL QUANTITATION LIMITS, AND INSTRUMENT CALIBRATION REQUIREMENTS

4.3.1 Method Detection Limits

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The laboratory shall establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project. The laboratory shall revalidate these MDLs on an annual basis. The laboratory shall provide the MDL demonstrations to AFCEE at the beginning of the project (i.e., before project samples are analyzed) and upon request in the format specified in Section 8. Results less than the MDL shall be reported as the MDL value and flagged with a "U" (see Section 8).

Laboratories participating in this work effort shall demonstrate the MDLs for each instrument, including confirmatory columns, method of analysis, analyte, and matrix (i.e., water and soil) using the following instructions:

- (1) Obtain the concentration value that corresponds to:
 - a) an instrument signal/noise ratio within the range of 2.5 to 5.0, or
 - b) the region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).
- (2) Analyze seven replicates of a matrix spike (ASTM Type II water for aqueous methods, Ottawa sand for soil methods) containing the analyte of interest at a concentration three to five times the estimated MDL.
- (3) Determine the variance (S^2) for each analyte as follows:

$$S^2 = \frac{1}{n-1} \left[\sum_{i=1}^n (x_i - \bar{x})^2 \right]$$

where x_i = the i th measurement of the variable x and \bar{x} = the average value of x

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

- (4) Determine the standard deviation (s) for each analyte as follows:

$$s = (S^2)^{1/2}$$

(5) Determine the MDL for each analyte as follows:

$$\text{MDL} = 3.14(s)$$

(note: 3.14 is the one-sided t-statistic at the 99 percent confidence level appropriate for determining the MDL using 7 samples)

4.3.2 Practical Quantitation Limits

The practical quantitation limit (PQL) is the lowest level that can be reasonably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The laboratories participating in this work effort shall compare the results of the MDL demonstrations to the PQLs for each method that is listed in Section 7. All MDLs shall be lower than the relevant PQLs. The laboratories shall also verify PQLs by including a standard at or below the PQL as the lowest point on the calibration curve. All results shall be reported at or above the MDL values, however, for those results falling between the MDL and the PQL, an "F" flag shall be applied to the results indicating the variability associated with the result (see Section 8.0).

4.3.3 Instrument Calibration

Analytical instruments shall be calibrated in accordance with the analytical methods. All analytes reported shall be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified in Section 7. Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards shall be traceable to standard materials.

Instrument calibration shall be checked using all of the analytes listed in the QC acceptance criteria table in Section 7 for the method. This applies equally to multiresponse analytes. All calibration criteria shall satisfy SW-846 requirements at a minimum. The initial calibration shall be checked at the frequency specified in the method using materials prepared independently of the calibration standards. Acceptance criteria for the calibration check are presented in Section 7. Analyte concentrations are determined with either calibration curves or response factors (RFs). For gas chromatography (GC) and gas chromatography/mass spectroscopy (GC/MS) methods, when using RFs to determine analyte concentrations, the average RF from the initial five point calibration shall be used. The continuing calibration shall not be used to update the RFs from the initial five point calibration.

4.4 ELEMENTS OF QUALITY CONTROL

QC elements relevant to screening data are presented in Section 6.0. This section presents QC requirements relevant to analysis of environmental samples that shall be followed during all analytical activities for fixed-base, mobile, and field laboratories producing definitive data. The purpose of this QC program is to produce data of known quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements through the use of QC materials.

Laboratory QC samples (e.g., blanks and laboratory control samples) shall be included in the preparation batch with the field samples. An AFCEE analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents. Matrix spikes and matrix spike duplicates count as environmental samples. The term AFCEE analytical batch also extends to cover samples that do not need separate extraction or digestion (e.g., volatile analyses by purge and trap). This AFCEE analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) analyzed sequentially within a calibration period. The identity of each AFCEE analytical batch shall be unambiguously reported with the analyses so that a reviewer can identify the QC samples and the associated environmental samples. All references to the analytical batch in the following sections and tables in this QAPP refer to the AFCEE analytical batch.

The type of QC samples and the frequency of use of these samples are discussed below and in the method-specific subsections of Section 7.

4.4.1 Laboratory Control Sample

The laboratory control sample (LCS) is analyte-free water (for aqueous analyses) or Ottawa sand (for soil analyses) spiked with known concentrations of all analytes listed in the QC acceptance criteria table in Section 7 for the method. The LCS shall be carried through the complete sample preparation and analysis procedure.

The LCS is used to evaluate each AFCEE analytical batch and to determine if the method is in control.

One LCS shall be included in every AFCEE analytical batch.

The performance of the LCS is evaluated against the QC acceptance limits given in the tables in Section 7.

Whenever an analyte in an LCS is outside the acceptance limit, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, all samples in the AFCEE analytical batch shall be reanalyzed for the out-of-control analyte(s). When an analyte in an LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to all affected results.

4.4.2 Matrix Spike/Matrix Spike Duplicate

A matrix spike (MS) and matrix spike duplicate (MSD) is an aliquot of sample spiked with known concentrations of all analytes listed in the QC acceptance criteria table in Section 7 for the method. The spiking occurs prior to sample preparation and analysis. Only AFCEE samples shall be used for spiking. The MS/MSD shall be designated on the chain of custody.

The MS/MSD is used to document the bias of a method due to sample matrix. AFCEE does not use MSs and MSDs to control the analytical process.

A minimum of one MS and one MSD sample shall be analyzed for every 20 AFCEE samples.

The performance of the MS and MSD is evaluated against the QC acceptance limits given in the tables in Section 7. If either the MS or the MSD is outside the QC acceptance limits, the analytes in all related samples shall be qualified according to the data flagging criteria in Sections 7 and 8.

4.4.3 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples.

Surrogates are used to evaluate accuracy, method performance, and extraction efficiency.

Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

Whenever a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been reestablished, reprep and reanalyze the sample. If corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.4 Internal Standards

Internal standards (ISs) are measured amounts of certain compounds added after preparation or extraction of a sample.

They are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects.

ISs shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

When the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning shall be reanalyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.5 Retention Time Windows

Retention time windows are used in GC and high performance liquid chromatography (HPLC) analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846 Method 8000A.

When the retention time is outside of the acceptance limits, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, reanalyze all samples analyzed since the last acceptable retention time check. If corrective actions are not performed, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.6 Interference Check Sample

The interference check sample (ICS), used in inductively coupled plasma (ICP) analyses only, contains both interfering and analyte elements of known concentrations

The ICS is used to verify background and interelement correction factors.

The ICS is run at the beginning and end of each run sequence.

When the interference check sample results are outside of the acceptance limits stated in the method, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, reanalyze the ICS. If the ICS result is acceptable, reanalyze all affected samples. If corrective action is not performed or the corrective action was ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to all affected results.

4.4.7 Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure.

The method blank is used to document contamination resulting from the analytical process.

A method blank shall be included in every AFCEE analytical batch.

The presence of analytes in a method blank at concentrations greater than the PQL indicates a need for corrective action. Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples in the analytical batch shall be reprep and reanalyzed. No analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples and corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.8 Ambient Blank

The ambient blank consists of ASTM Type II reagent grade water poured into a volatile organic compound (VOC) sample vial at the sampling site (in the same vicinity as the associated samples). It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection.

The frequency of collection for ambient blanks is specified in Section 2.2.4 of the SAP. Ambient blanks shall be collected downwind of possible VOC sources.

4.4.9 Equipment Blank

An equipment blank is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis.

Equipment blanks are used to assess the effectiveness of equipment decontamination procedures.

The frequency of collection for equipment blanks is specified in Section 2.2.4 of the SAP. Equipment blanks shall be collected immediately after the equipment has been decontaminated. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

When an analyte is detected in the equipment blank the appropriate validation flag, as described in Section 8, shall be applied to all sample results from samples collected.

4.4.10 Trip Blank

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures.

When an analyte is detected in the trip blank the appropriate validation flag, as described in Section 8, shall be applied to all sample results from samples in the cooler with the affected trip blank.

One trip blank shall accompany each cooler of samples sent to the laboratory for analysis of VOCs.

4.4.11 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner

during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest.

The frequency of collection for field duplicates is specified in Section 2.2.4 of the SAP.

4.4.12 Field Replicates

A field replicate sample, also called a split, is a single sample divided into two equal parts for analysis. The sample containers are assigned an identification number in the field such that they cannot be identified as replicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field replicate samples prior to the beginning of sample collection.

Replicate sample results are used to assess precision.

The frequency of collection for field replicates is specified in Section 2.2.4 of the SAP.

4.5 QUALITY CONTROL PROCEDURES

4.5.1 Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. The holding time begins at the time of sample collection. Some methods have more than one holding time requirement (e.g., methods SW8080A, SW8270B, etc.). The preparation holding time is calculated from the time of sample collection to the time of completion of the sample preparation process as described in the applicable method, prior to any necessary extract cleanup and/or volume reduction procedures. If no preparation (e.g., extraction) is required, the analysis holding time is calculated from the time of sample collection to the time of completion of all analytical runs, including dilutions, second-column confirmations, and any required reanalyses. In methods requiring sample preparation prior to analysis, the analysis holding time is calculated from the time of preparation completion to the time of

completion of all analytical runs, including dilutions, second-column confirmations, and any required reanalyses.

If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures as described in Section 8.

4.5.2 Confirmation

Quantitative confirmation of results at or above the PQL for samples analyzed by GC or HPLC shall be required and shall be completed within the method-required holding times. For GC methods, a second-column is used for confirmation. For HPLC methods, a second column or a different detector is used. The result of the first column/detector shall be the result reported. If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures as described in Section 8.

4.5.3 Standard Materials

Standard materials used in calibration and to prepare samples shall be traceable to National Institute Standards and Technology (NIST), EPA, American Association of Laboratory Accreditation (A2LA) or other equivalent AFCEE approved source, if available. If an NIST, EPA or A2LA standard material is not available, the standard material proposed for use shall be included in an addendum to the SAP and approved before use. The standard materials shall be current, and the following expiration policy shall be followed: The expiration dates for ampulated solutions shall not exceed the manufacturer's expiration date or one year from the date of receipt, whichever comes first. Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first. Expiration dates for pure chemicals shall be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions. Expired standard materials shall be either revalidated prior to use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory shall label standard and QC materials with expiration dates.

4.5.4 Supplies and Consumables

The laboratory shall inspect supplies and consumables prior to their use in analysis. The materials description in the methods of analysis shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be

monitored by analysis of LCSs. An inventory and storage system for these materials shall assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

5.0 SAMPLING PROCEDURES

5.1 FIELD SAMPLING

The field sampling procedures for collecting samples and sampling methods shall be included in Section 6.0 of the FSP.

5.1.1 Sample Containers

Sample containers are purchased precleaned and treated according to EPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the EPA-recommended procedures (i.e., EPA 540/R-93/051). Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

5.1.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in Table 5.1.2-1. The required sample volumes, container types, and preservation requirements for analytical methods proposed for project work not listed in Table 5.1.2-1 shall be included in an addendum to the FSP and approved by AFCEE before use.

Table 5.1.2-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container ^a	Preservation ^{b,c}	Minimum Sample Volume or Weight	Maximum Holding Time
Alkalinity	E310.1	P, G	4°C	50 mL	14 days
Common anions	SW9056	P, G	None required	50 mL	28 days for Br ⁻ , F ⁻ , Cl ⁻ , and SO ₄ ²⁻ ; 48 hours for NO ₃ ⁻ , NO ₂ ⁻ and PO ₄ ³⁻
Cyanide, total and amenable to chlorination	SW9010A SW9012	P, G, T	4°C; NaOH to pH > 12, 0.6 g ascorbic acid	500 mL or 4 ounces	14 days (water and soil)
Filterable residue	E160.1	P, G	4°C	100 mL	7 days
Nonfilterable residue	E160.2	P, G	4°C	100 mL	7 days
Hydrogen ion (pH) (W, S)	SW9040/ SW9045	P, G	None required	N/A	Analyze immediately
Nitrogen, nitrate+nitrite	E353.1	P, G	4°C, H ₂ SO ₄ to pH < 2	500 mL	28 days

Table 5.1.2-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container ^a	Preservation ^{b,c}	Minimum Sample Volume or Weight	Maximum Holding Time
Conductance	SW9050	P, G	None required	N/A	Analyze immediately
Temperature	E170.1	P, G	None required	N/A	Analyze immediately
Dissolved oxygen	E360.1	G	None required	500 mL	Analyze immediately
Turbidity	E180.1	P, G	4°C	N/A	48 hours
Total organic carbon	SW9060	P, G, T	4°C, HCl or H ₂ SO ₄ to pH < 2	500 mL or 4 ounces	28 days (water and soil)
Chromium (VI)	SW7196	P, G, T	4°C	500 mL or 8 ounces	24 hours (water and soil) ^d
Mercury	SW7470 SW7471	P, G, T	HNO ₃ to pH < 2, 4°C	500 mL or 8 ounces	28 days (water and soil)
Metals (except chromium (VI) and mercury)	SW6010A SW6020 and SW-846 AA methods	P, G, T	HNO ₃ to pH < 2, 4°C	500 mL or 8 ounces	180 days (water and soil)
Total petroleum hydrocarbons (TPH)-volatile	SW8015 (modified)	G, Teflon-lined septum, T	4°C, HCl to pH < 2	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Total petroleum hydrocarbons (TPH)-extractable	SW8015 (modified)	G, amber, T	4°C	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Volatile aromatics	SW8020A	G, Teflon-lined septum, T	4°C, HCl to pH < 2, 0.008% Na ₂ S ₂ O ₃	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Halogenated volatiles	SW8021A	G, Teflon-lined septum, T	4°C, HCl to pH < 2, 0.008% Na ₂ S ₂ O ₃	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Nitrosamines	SW8070	G, Teflon-lined cap, T	4°C	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Chlorinated herbicides	SW8150B SW8151	G, Teflon-lined cap, T	4°C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)

Table 5.1.2-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container ^a	Preservation ^{b,c}	Minimum Sample Volume or Weight	Maximum Holding Time
Organochlorine pesticides and polychlorinated biphenyls (PCBs)	SW8080A, SW8081,	G, Teflon-lined cap, T	4°C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organophosphorus pesticides/ compounds	SW8140 SW8141A	G, Teflon-lined cap, T	4°C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Semivolatile organics	SW8270B	G, Teflon-lined cap, T	4°C, 0.008% Na ₂ S ₂ O ₃	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Volatile organics	SW8240B SW8010B SW8260A	G, Teflon-lined septum, T	4°C, 0.008% Na ₂ S ₂ O ₃ (HCl to pH < 2 for volatile aromatics by SW8240 and SW8260) ^b	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Polynuclear aromatic hydrocarbons (PAHs)	SW8310	G, Teflon-lined cap, T	4°C, store in dark, 0.008% Na ₂ S ₂ O ₃	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Dioxins and furans	SW8280	G, Teflon-lined cap, T	4°C, 0.008% Na ₂ S ₂ O ₃	1 liter or 8 ounces	30 days until extraction and 45 days after extraction (water and soil)
Ethylene dibromide (EDB)	SW8011	G, Teflon-lined cap, T	4°C, 0.008% Na ₂ S ₂ O ₃	2 x 40 mL	28 days (water)
Explosive residues	SW8330	P, G, T	Cool, 4°C	1 liter or 8 ounces	7 days to extraction (water); 14 days to extraction (soil); analyze within 40 days after extraction
TCLP	SW1311	G, Teflon-lined cap, T	Cool, 4°C	1 liter or 8 ounces	14 days to TCLP extraction and 14 days after extraction (volatiles); 14 days to TCLP extraction and 40 days after extraction (semivolatiles); 28 days to TCLP extraction and 28 days after extraction (mercury); 180 days to TCLP extraction and 180 days after extraction (metals)

- a. Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T).
- b. No pH adjustment for soil.
- c. Preservation with 0.008 percent $\text{Na}_2\text{S}_2\text{O}_3$ is only required when residual chlorine is present.
- d. The maximum recommended holding time for completion of extraction into water is 48 hours. The extract shall be analyzed within 24 hours of completion of extraction.

5.2 SAMPLE HANDLING AND CUSTODY

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

The contractor shall maintain chain-of-custody records for all field and field Quality Control

(QC) samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view, after being in their possession, (3) it was in their possession and they locked it up or, (4) it is in a designated secure area.

The following information concerning the sample shall be documented on the AFCEE chain of custody (COC) form (as illustrated in Section 8):

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of MS/MSD
- Preservative used
- Analyses required
- Name of collector(s)
- Pertinent field data (pH, temperature, etc.)
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection in accordance with (IAW) Section 6.2 of the FSP.

Samples collected in the field shall be transported to the laboratory or field testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank (a volatile organics compounds sampling vial filled with tap water) shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory. When, in the judgment of the laboratory, the temperature of the samples upon receipt may have affected the stability of the analytes of interest, the problem shall be documented in laboratory records and discussed with AFCEE. The resolution of the problem shall also be documented.

Once the samples reach the laboratory, they shall be checked against information on the COC form for anomalies. The condition, temperature, and appropriate preservation of samples shall be checked and documented on the COC form. Checking an aliquot of the sample using pH paper is an acceptable procedure except for VOCs where an additional sample is required to check preservation. The occurrence of any anomalies in the received samples and their resolution shall be documented in laboratory records. All sample information shall then be entered into a tracking system, and unique analytical sample identifiers shall be assigned. A copy of this information shall be reviewed by the laboratory for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely for AFCEE work are specified in Table 5.1.2-1. **Samples not preserved or analyzed in accordance with these requirements shall be resampled and analyzed, at no additional cost to AFCEE.** Subcontracted analyses shall be documented with the AFCEE COC form. Procedures ensuring internal laboratory COC shall also be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

While in the laboratory, samples shall be stored in limited-access, temperature-controlled areas. Refrigerators, coolers and freezers shall be monitored for temperature seven days a week. Acceptance criteria for the temperatures of the refrigerators and coolers is 4°C ± 2°C. Acceptance criteria for the temperatures of the freezers shall be less than 0°C. All of the cold storage areas shall be monitored by thermometers that have been calibrated with a NIST-traceable thermometer. As indicated by the findings of the calibration, correction factors shall be applied to each thermometer. Records that include acceptance criteria shall be maintained. Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Samples shall be stored after analysis until disposed of IAW applicable local, state, and federal regulations. Disposal records shall be maintained by the laboratory.

Standard operating procedures (SOPs) describing sample control and custody shall be maintained by the laboratory.

6.0 SCREENING ANALYTICAL METHODS

The analytical screening methods contained in this section are shown in Table 6-1. This section includes brief descriptions of the methods and QC required for screening procedures commonly used to conduct work efforts. The methods and QC procedures were taken from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (U.S. EPA SW-846, Third Edition, and its first and second update), *Methods for Chemical Analysis of Water and Waste* (U.S. EPA 1979), *ASTM Annual Book of Standards* (1993), and from manufacturers' literature.

Table 6-1. Screening Analytical Methods

Method	Parameter
SW846 (3550)	Moisture
SW9040	pH (water)
SW9045	pH (soil)
SW9050	Conductance
SW9060	Total organic carbon
E160.1	Filterable residue
E160.2	Nonfilterable residue
E170.1	Temperature
E180.1	Turbidity
E310.1	Alkalinity
E360.1	Dissolved oxygen
Organic Vapor (FID and PID)	Soil gas screening-halogenated, aromatic, and petroleum hydrocarbons
ASTM D422	Particle size
ASTM D1498	Oxidation-reduction potential
ASTM D3416	Methane
SW4020	PCBs by Immunoassay
SW4030	TPH by Immunoassay

6.1 ANALYTICAL SCREENING METHOD DESCRIPTIONS

Section 6.1 contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- The PQL (if applicable)

6.1.1 EPA Method SW9040 (WATER)/SW9045 (SOIL)-pH

pH measurements shall be performed for water samples using method SW9040. pH measurements of soil samples are performed using method SW9045. Measurements are determined electrometrically using either a glass electrode in combination with a reference potential, or a combination electrode.

6.1.2 EPA Method SW9050-Conductance

Standard conductivity meters are used. Temperature is also reported.

6.1.3 EPA Method SW9060-Total Organic Carbon

Organic carbon is measured using a carbonaceous analyzer. This instrument converts the organic carbon in a sample to carbon dioxide by either catalytic combustion or wet chemical oxidation. The carbon dioxide formed is then either measured directly by an infrared detector or converted to methane and measured by a flame ionization detector. The amount of carbon dioxide or methane in a sample is directly proportional to the concentration of carbonaceous material in the sample.

Method	Analyte	Water	
		PQL	Unit
SW9060	Total organic carbon	1	mg/L

6.1.4 EPA Method 160.1-Filterable Residue

A well-mixed sample is filtered through a standard glass fiber filter. The filtrate is evaporated and dried to constant weight at 180 °C.

Method	Analyte	Water	
		PQL	Unit
E160.1	Total dissolved solids	10	mg/L

6.1.5 EPA Method 160.2-Nonfilterable Residue

A well-mixed sample is filtered through a glass fiber filter, and the residue retained on the filter is dried to constant weight at 103-105 °C.

Method	Analyte	Water	
		PQL	Unit
E160.2	Total suspended solids	5	mg/L

6.1.6 EPA Method 170.1–Temperature

Temperature measurements are made with a mercury-filled or dial type centigrade thermometer, or a thermistor.

6.1.7 EPA Method 180.1–Turbidity

This method is based on a comparison of the light scattered by the sample under defined conditions with the light intensity scattered by a standard reference suspension. The higher the intensity, the greater the turbidity. Turbidity measurements are made in a nephelometer and are reported in terms of nephelometric turbidity units (NTUs). The working range for the method is from 0–40 NTU. Higher levels of turbidity can be measured by diluting the sample with turbidity-free deionized water.

6.1.8 EPA Method 310.1–Alkalinity

In this method, an unaltered sample is titrated to an end point of pH 4.5 using hydrochloric or sulfuric acid.

Method	Analyte	Water	
		PQL	Unit
E360.1	Alkalinity ¹	10	mg/L

¹ alkalinity measured as calcium carbonate equivalence

6.1.9 EPA Method 360.1–Dissolved Oxygen

An instrumental probe, usually dependent upon an electrochemical reaction, is used for determination of dissolved oxygen in water. Under steady-state conditions, the current or potential can be correlated with dissolved oxygen concentrations.

6.1.10 ASTM D422–Standard Method for Particle-Size Analysis of Soils

This method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 μm (retained on the No. 200

sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μm is determined by a sedimentation process using a hydrometer.

6.1.11 ASTM D1498—Oxidation-Reduction Potential

This method is designed to measure the oxidation-reduction potential (ORP) in water, which is defined as the electromotive force between a noble metal electrode and a reference electrode when immersed in a solution.

6.1.12 ASTM D3416—Methane in Soil Gas

An aliquot of the soil gas sample is introduced into a prechromatographic or stripper column which removes hydrocarbons other than methane and carbon monoxide. Methane and carbon monoxide are passed through a chromatographic column where they are separated. The methane is measured by a flame ionization detector (FID). Quantitation is performed by comparing the sample response to the response of a known concentration of methane.

6.1.13 Draft Method SW4020—Screening for Polychlorinated Biphenyls by Immunoassay

Soil samples are screened for total polychlorinated biphenyls (PCBs) using immunoassay test kits. A mini methanol extraction of the soil sample is performed, and the extract and an enzyme conjugate reagent are added to immobilized antibodies. The enzyme conjugate competes with the PCBs in the sample for binding to immobilized anti-PCB antibodies. The test is interpreted by comparing the response produced by the sample to the response produced by a standard.

6.1.14 Draft Method SW4030—Screening for Petroleum Hydrocarbons by Immunoassay

Soil samples are screened for levels of total petroleum hydrocarbons (TPH) using TPH test kits. A mini extraction of the soil sample is performed, and the extract and an enzyme conjugate reagent are added to immobilized antibodies. The enzyme conjugate competes with hydrocarbons for binding to immobilized anti-hydrocarbon antibodies. The test is interpreted by comparing the response produced by the sample to the response produced by a standard.

6.1.15 SW-846 (Described in Method SW3550)—Percent Moisture

Percent moisture is determined for solid samples undergoing analysis for inorganic and organic analytes. The sample is weighed, dried, and then reweighed. Percent moisture is calculated as:

$$\frac{\text{Initial Weight} - \text{Dried Weight}}{\text{Initial Weight}} \times 100 = \% \text{ moisture}$$

The moisture content is used to calculate results for soil samples on a dry weight basis using the calculation presented below:

$$\frac{\text{Result of analysis on wet weight basis}}{100 - \% \text{ Moisture}} = \text{Result of analysis on a dry weight basis}$$

All soil or sediment results and detection limits shall be reported on a dry weight basis.

6.1.16 Real-Time Portable Organic Vapor Analyzers

Two types of portable analyzers shall be used to perform real-time nonspecific analyses of hydrocarbon vapors. The instruments include an FID (e.g., Foxboro Century OVA) and a photoionization detector (PID) (e.g., HNu® Systems [HNu®] trace gas analyzer) organic vapor monitor. One or more of these instruments may be used at a specific site, depending on the contaminant species of interest. When used together, the instruments provide complementary information because they are sensitive to different types of hydrocarbon vapors.

The portable analyzers shall be used as a screening tool to help determine the optimum locations for the collection of samples. Field data recorded on the COC forms give the laboratory analysts an indication of the approximate concentration of contaminants and aid in calculating dilution factors before analysis. Additionally, the real-time instruments are used to aid in selecting the proper level of personal protective equipment and monitoring air emissions during sampling activities. The comparability of results obtained from the PID and FID instruments can be considered only to be within the variability of this type of screening instrument. Comparability is greatest when the instruments are calibrated with the same standards and operated within similar concentration ranges.

The FID uses the principle of hydrogen flame ionization to detect and measure total hydrocarbon vapors. The FID has a dynamic operating range from 1 ppmv to 10 ppmv or 1 ppmv to 100,000 ppmv, depending on the instrument, and provides a nonspecific response to total hydrocarbons. If concentrations exceed the range of the instrument, a dilution probe shall be attached to the FID to allow elevated vapor concentrations to be measured. The instrument is highly sensitive to compounds such as methane, benzene, and acetone, but is less sensitive to alcohols and halogenated compounds.

During operation, a sample is drawn into the probe and transmitted to the detection chamber by an internal pumping system. Inside the chamber, the sample is exposed

to a hydrogen flame that ionizes the organic vapors. As the organic vapors burn, the ions produced are collected on an electrode in the chamber, and a current proportional to the hydrocarbon concentration is generated. This current is measured and displayed on the meter.

The PID uses a photoionization detector to detect and measure total hydrocarbon vapors. The instrument has an operating range of 0-2,000 ppm. During operation, a gas sample is drawn into the probe and past an ultraviolet light source by an internal pumping system. Contaminants in the sample are ionized, producing an instrument response if their ionization potential is equal to or less than the ionizing energy supplied by the lamp. The radiation produces a free electron for each molecule of ionized contaminant, which generates a current directly proportional to the number of ions produced. This current is measured and displayed on the meter. The PID measures the *total* value for all species present with ionization potentials less than or equal to that of the lamp.

6.2 CALIBRATION AND QC PROCEDURES FOR SCREENING METHODS

All screening data shall be flagged with an "S" data qualifier to show the reported data are screening data (see Section 8). The other data qualifiers that shall be used with screening data are also shown in Table 6.2-2 and Section 8. Flagging criteria are applied (except for the "S" flag) when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

Table 6.2-1 presents the calibration and QC procedures for each method. These requirements as well as the corrective actions and data flagging criteria are included. In this table, the first two columns designate the method number and the class of analytes that may be determined by the method. The third column lists the method-required calibration and QC elements. The fourth column designates the minimum frequency for performing each calibration and QC element. The fifth column designates the acceptance criteria for each calibration and QC element. The sixth column designates the corrective action in the event that a calibration or QC element does not meet the acceptance criteria. The last column designates the data flagging criteria that must be applied in the event that the method-required calibration and QC acceptance criteria are not met.

Table 6.2-1. Summary of Calibration and QC Procedures for Screening Methods

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria ^b
SW-846 ^c	Moisture	Duplicate sample	1 per 20 samples	% solid RPD \leq 15%	Correct problem, repeat measurement. If still out, flag data	J
				RPD > 30%		R
SW9045	pH (soil)	2-point calibration with pH buffers	1 per 10 samples analyzed	± 0.05 pH unit	Check with new buffers; if still out, repair meter; repeat calibration check	R
		pH 7 buffer	At each sample location	± 0.1 pH unit	Recalibrate	R
		Duplicate sample	10% of field samples	± 0.1 pH unit	Correct problem, repeat measurement. If still out, repeat calibration and reanalyze samples	J
SW9050	Conductance	Calibration with KCl standard	Once per day at beginning of testing	$\pm 5\%$	If calibration is not achieved, check meter, standards, and probe; recalibrate	R
		Field duplicate	10% of field samples	$\pm 5\%$	Correct problem, repeat measurement	J
SW9040	pH (water)	2-point calibration with pH buffers	Once per day	± 0.05 pH units for every buffer	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration	R
		pH 7 buffer	At each sample location	± 0.1 pH units	Correct problem, recalibrate	R
		Field duplicate	10% of field samples	± 0.1 pH units	Correct problem, repeat measurement	J
E170.1	Temperature	Field duplicate	10% of field samples	$\pm 1.0^{\circ}\text{C}$	Correct problem, repeat measurement	J

Table 6.2-1. Summary of Calibration and QC Procedures for Screening Methods

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria ^b
E180.1	Turbidity	Calibration with one formazin standard per instrument range used	Once per day at beginning of testing	± 5 units, 0–100 range ± 0.5 units, 0–0.2 range ± 0.2 units, 0–1 range	If calibration is not achieved, check meter; replace if necessary, recalibrate	R
		Field duplicate	10% of field samples	RPD ≤ 20%	Correct problem, repeat measurement	J
None	Organic vapor concentrations (FID and PID)	3 point calibration	Monthly	correlation coefficient ≥ 0.995	Recalibrate; check instrument and replace if necessary	R
		Calibration verification and check	Daily at beginning and end of day	Response ± 20% of expected value	Correct problem, recalibrate	R
SW9060	Total organic carbon	Method blank	Daily or one per batch, whichever is more frequent	< PQL	Clean system; reanalyze blank. Repeat until analyte < PQL	B
		Field duplicate	10% of field samples	RPD < 20%	Repeat measurement	J
E160.1	Filterable residue	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
E160.2	Nonfilterable residue	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
ASTM D1498	Oxidation-reduction potential	Sensitivity verification	Daily	ORP should decrease when pH is increased	If ORP increases, correct the polarity of electrodes. If ORP still does not decrease, clean electrodes and Repeat procedure	R
		Calibration with one standard	Once per day	Two successive readings ± 10 millivolts	Correct problem, recalibrate	R
		Field duplicate	10% of field samples	± 10 millivolts	Correct problem, repeat measurement	J
E310.1	Alkalinity	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J

Table 6.2-1. Summary of Calibration and QC Procedures for Screening Methods

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria ^b
E360.1	Dissolved oxygen	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
SW4020	PCBs by immunoassay	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
SW4030	Petroleum hydrocarbons by immunoassay	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
ASTM D3416	Methane	Single point calibration	Daily, prior to sample analysis	Delineation from database average within $\pm 20\%$	Recalibrate	R
		Method blank	Daily or one per batch, whichever is more frequent	< PQL	Clean system; reanalyze blank and Repeat until all analytes < PQL	B
		Duplicate	1 per batch or 10%	RPD $\leq 20\%$	Analyze third aliquot: if still out, flag data	J

- All corrective actions shall be documented, and the records shall be maintained by the prime contractor.
- All screening results shall first be flagged with an "S" and also any other appropriate validation flags identified in the Data Flagging Criteria column of the table. For example "SJ", "SB", "SR".
- Described in method SW3550.

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7.0 DEFINITIVE DATA ANALYTICAL METHODS AND PROCEDURES

Section 7.1 contains brief descriptions of preparation methods. Section 7.2 contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- A table of PQLs
- A table of QC acceptance criteria
- A table of calibration procedures, QC procedures, and data validation guidelines

This information was obtained from the *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (U.S. EPA SW-846, Third Edition, and its first and second update); *Handbook for the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS)* (Handbook), September 1993; *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, D.C., Publication 9240.1-05-01, EPA-540/R-94-013, PB94-963502, February 1994; and *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, D.C., Publication 9240.1-05, EPA-540/R-94-012, PB94-963501, February 1994. Definitions of terms are given in Section 4.0, and data validation guidelines are presented in Section 8.0.

7.1 PREPARATION METHODS

Extraction and digestion procedures for liquid and solid matrices presented in this section are outlined in Table 7.1-1. The appropriate preparation method to be used (if applicable) for each analytical method is given in the PQL tables.

Table 7.1-1. Extraction and Digestion Procedures

Method	Parameter
SW1311	Toxicity Characteristic Leaching Procedure
SW3005A	Acid Digestion of Water Samples for Metals Analysis
SW3020A	Acid Digestion of Aqueous Samples and Extracts for Metals Analysis
SW3050A	Acid Digestion for Solids, Sediments, and Sludges for Metals Analysis
SW3510B	Separatory Funnel Liquid-Liquid Extraction
SW3540B/SW3541	Soxhlet Extraction
SW3550A	Ultrasonic Extraction
SW5030A	Purge and Trap Method

7.1.1 Method SW1311--Toxicity Characteristic Leaching Procedure

Method SW1311 is used to prepare samples for determination of the concentration of organic (semivolatile and volatile) and inorganic constituents that are leachable from waste or other material.

QC is accomplished by preparing a toxicity characteristic leaching procedure (TCLP) blank at a rate of one blank for every 20 extractions conducted in the extraction vessel. Additional extract is prepared so one MS is performed for each waste type (samples of similar waste types shall be batched together). One MS must be analyzed in each AFCEE analytical batch. These QA measures are in accordance with the requirements of EPA method SW1311, Section 8.0.

7.1.2 Method SW3005A--Acid Digestion of Water Samples for Metals Analysis

This method is an acid digestion procedure used to prepare water samples for metals analysis. The digested samples are analyzed for total recoverable and dissolved metals determination by either flame atomic absorption (FLAA) or inductively coupled plasma (ICP).

For analysis of total recoverable metals, the entire sample is acidified at collection time.

For analysis of dissolved metals, upon collection the samples are filtered then acidified.

7.1.3 Method SW3020A-- Acid Digestion of Aqueous Samples and Extracts for Metals Analysis

Method SW3020A prepares aqueous or waste samples for total metals determination by graphite furnace atomic absorption spectroscopy (GFAA). The samples are vigorously digested with acid and then diluted.

7.1.4 Method SW3050A--Acid Digestion for Solids, Sediments, and Sludges for Metals Analysis

Method SW3050A is applicable to the preparation of sediment, sludge, and soil samples for metals analysis by FLAA or GFAA or ICP.

A sample is digested then refluxed with acid. A separate aliquot of the sample is dried for a total solids and/or percent moisture determination.

7.1.5 Method SW3510B-Separatory Funnel Liquid-Liquid Extraction

Method SW3510B is designed to quantitatively extract nonvolatile and SVOCs from liquid samples using standard separatory funnel techniques. The sample and the extracting solvent must be immiscible in order to yield recovery of target compounds. Subsequent cleanup and detection methods are described in the organic analytical method used to analyze the extract.

7.1.6 Method SW3540B/SW3541-Soxhlet Extraction

Method SW3540B is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils and sludges. Method SW3541 is an automated Soxhlet extraction. The Soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent.

7.1.7 Method SW3550A-Ultrasonic Extraction

Method SW3550A is a procedure for extracting nonvolatile and SVOCs from solids such as soils and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent.

7.1.8 Method SW5030A-Purge and Trap Method

Method SW5030A describes sample preparation and extraction for the analysis of VOCs. The method is applicable to nearly all types of samples, including aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, water, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments. The success of this method depends on the level of interferences in the sample. Results may vary due to the large variability and complexity of matrices of solid waste samples.

An inert gas is then bubbled through the a sample solution at ambient temperature to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a GC column. For SW8020A, drying of the trap for under a helium flow is required. For methods SW8010B and SW8020A, the GC column is heated to elute the components that are detected by an appropriate detector.

7.2 ANALYTICAL PROCEDURES

The analytical procedures presented in this section are outlined in Table 7.2-1.

A brief description and three tables for each method are included in the following subsections. The first table presents the PQLs for each analyte in the method. The PQLs are presented for both soil and water matrices. The second table presents the acceptance criteria for the accuracy of spiked analyte and surrogate recoveries. This table also presents the acceptance criteria for the precision of matrix, field, and laboratory duplicate recoveries. The third table presents the calibration and QC procedures for each method. Corrective actions and data flagging criteria are also included in this table.

In the third table, the first two columns designate the method number and the class of analytes that may be determined by the method. The third column lists the method-required calibration and QC elements. The fourth column designates the minimum frequency for performing each calibration and QC element. The fifth column designates the acceptance criteria for each calibration and QC element. The sixth column designates the corrective action in the event that a calibration or QC element does not meet the acceptance criteria. The last column designates the data flagging criteria that shall be applied in the event that the method-required calibration and QC acceptance criteria are not met.

Table 7.2-1. Analytical Procedures

SW Methods	Parameter
8010B	Halogenated volatiles (water and soil)
8011	Ethylene dibromide (EDB) (water)
8015 (modified)	TPH volatile and extractable (water and soil)
8020A	Aromatic volatile organics (water and soil)
8021A	Halogenated volatile organics (water and soil)
8070	Nitrosamines (water and soil)
8080A	Organochlorine pesticides and PCBs (water and soil)
8081	Organochlorine pesticides and PCBs (water and soil)
8140	Organophosphorus pesticides (water and soil)
8141A	Organophosphorus compounds (water and soil)
8150B	Chlorinated herbicides (water and soil)
8151	Chlorinated herbicides (water and soil)
8240B	Volatile organics (water and soil)
8260A	Volatile organics (water and soil)
8270B	Semivolatile organics (water and soil)
8280	Dioxins and furans (water and soil)
8310	Polynuclear aromatic hydrocarbons (PAHs) (water and soil)
8330	Explosive residues (water and soil)
6010A	Trace metals by ICP (water and soil)
6020	Trace metals by ICP-MS (water and soil)
7041	Antimony (water and soil)
7060A	Arsenic (water and soil)
7131A	Cadmium (water and soil)
7191	Chromium (water and soil)
7196	Hexavalent chromium
7421	Lead (water and soil)
7470A	Mercury (water)
7471A	Mercury (soil)
7740	Selenium (water and soil)
7841	Thallium (water and soil)
7911	Vanadium (water and soil)
9010A	Cyanide (water)
9012	Cyanide (water)
9056	Common anions

7.2.1 Method SW8010B-Halogenated Volatile Organics

Halogenated volatile organics in water and soil samples are analyzed using method SW8010B. This method is a purge and trap GC method using preparation method SW5030A. An inert gas is bubbled through a water matrix to transfer the volatile halocarbons from the liquid to the vapor phase. The volatile compounds are removed from the inert gas by passing the gas through a sorbent trap, which is then backflushed onto a GC column with an electrolytic conductivity detector to separate and quantify the compounds of interest. Soil samples are analyzed by direct purge and trap (for low-level samples) or by extraction of the sample. The practical quantitation limit (PQL) for the organic analytes are presented in Table 7.2.1-1.

This method provides for the use of a second GC column of a dissimilar polarity to resolve compounds of interest from interferences that may occur. When second-column analysis is performed, retention times for the analyte must match those established for each column. Otherwise, the chromatographic peaks are considered interferences, and the analyte is not considered to be present in the sample. Requirements for confirmation of analytes are described in Section 4.5.2. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.1-2 and 7.2.1-3.

Table 7.2.1-1. PQLs for Method SW8010B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Purgeable Halocarbons SW5030A/SW8010B (W, S)	1,1,1,2-Tetrachloroethane	5.0	µg/L	0.005	mg/kg
	1,1,1-TCA	1.0	µg/L	0.005	mg/kg
	1,1,2,2-Tetrachloroethane	1.0	µg/L	0.005	mg/kg
	1,1,2-TCA	1.0	µg/L	0.005	mg/kg
	1,1-DCA	1.0	µg/L	0.005	mg/kg
	1,1-DCE	1.0	µg/L	0.005	mg/kg
	1,2,3-Trichloropropane	10.0	µg/L	0.01	mg/kg
	1,2-DCA	1.0	µg/L	0.005	mg/kg
	1,2-DCB	2.0	µg/L	0.005	mg/kg
	1,2-Dichloropropane	1.0	µg/L	0.005	mg/kg
	1,3-DCB	3.0	µg/L	0.005	mg/kg
	1,4-DCB	2.0	µg/L	0.005	mg/kg
	1-Chlorohexane	5.0	µg/L	0.005	mg/kg
	2-Chloroethyl Vinyl Ether	10.0	µg/L	0.01	mg/kg
	Bromobenzene	5.0	µg/L	0.05	mg/kg
	Bromodichloromethane	1.0	µg/L	0.005	mg/kg
	Bromoform	2.0	µg/L	0.05	mg/kg
	Bromomethane	10.0	µg/L	0.01	mg/kg
	Carbon Tetrachloride	1.0	µg/L	0.005	mg/kg
	Chlorobenzene	2.5	µg/L	0.005	mg/kg
	Chloroethane	5.0	µg/L	0.005	mg/kg
	Chloroform	0.5	µg/L	0.005	mg/kg
	Chloromethane	1.0	µg/L	0.005	mg/kg
	Cis-1,2-DCE	1.0	µg/L	0.005	mg/kg
	Cis-1,3-Dichloropropene	5.0	µg/L	0.005	mg/kg
	Dibromochloromethane	1.0	µg/L	0.005	mg/kg
	Dibromomethane	5.0	µg/L	0.005	mg/kg
	Methylene Chloride	2.0	µg/L	0.005	mg/kg
	TCE	1.0	µg/L	0.005	mg/kg
	Tetrachloroethylene	1.0	µg/L	0.005	mg/kg
	Trans-1,2-DCE	1.0	µg/L	0.005	mg/kg
	Trans-1,3-Dichloropropene	3.0	µg/L	0.005	mg/kg
	Trichlorofluoromethane	1.0	µg/L	0.005	mg/kg
	Vinyl Chloride	2.0	µg/L	0.005	mg/kg

Table 7.2.1-2. QC Acceptance Criteria for Method SW8010B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8010B	1,1,1,2-Tetrachloroethane	75-125	≤ 20	65-135	≤ 30
	1,1,1-TCA	69-134	≤ 20	59-144	≤ 30
	1,1,2,2-Tetrachloroethane	30-166	≤ 20	20-176	≤ 30
	1,1,2-TCA	61-130	≤ 20	51-140	≤ 30
	1,1-DCA	64-127	≤ 20	54-137	≤ 30
	1,1-DCE	53-147	≤ 20	43-157	≤ 30
	1,2,3-Trichloropropane	75-130	≤ 20	65-140	≤ 30
	1,2-DCA	68-137	≤ 20	58-147	≤ 30
	1,2-DCB	65-129	≤ 20	55-139	≤ 30
	1,2-Dichloropropane	73-124	≤ 20	63-134	≤ 30
	1,3-DCB	63-137	≤ 20	53-147	≤ 30
	1,4-DCB	66-135	≤ 20	56-145	≤ 30
	1-Chlorohexane	75-130	≤ 20	65-140	≤ 30
	2-Chloroethyl Vinyl Ether	61-140	≤ 20	51-150	≤ 30
	Bromobenzene	75-125	≤ 20	65-115	≤ 30
	Bromodichloromethane	61-135	≤ 20	51-145	≤ 30
	Bromoform	58-129	≤ 20	48-139	≤ 30
	Bromomethane	68-125	≤ 20	58-135	≤ 30
	Carbon Tetrachloride	69-139	≤ 20	59-149	≤ 30
	Chlorobenzene	75-137	≤ 20	65-147	≤ 30
	Chloroethane	75-130	≤ 20	65-140	≤ 30
	Chloroform	49-133	≤ 20	39-143	≤ 30
	Chloromethane	59-154	≤ 20	49-164	≤ 30
	Cis-1,2-DCE	75-125	≤ 20	65-130	≤ 30
	Cis-1,3-Dichloropropene	75-130	≤ 20	65-140	≤ 30
	Dibromochloromethane	75-131	≤ 20	65-141	≤ 30
	Dibromomethane	75-130	≤ 20	65-140	≤ 30
	Methylene Chloride	42-176	≤ 20	32-166	≤ 30
	TCE	75-141	≤ 20	65-151	≤ 30
	Tetrachloroethylene	75-142	≤ 20	65-152	≤ 30
	Trans-1,2-DCE	78-130	≤ 20	65-140	≤ 30
	Trans-1,3-Dichloropropene	42-156	≤ 20	32-166	≤ 30
	Trichlorofluoromethane	75-130	≤ 20	65-140	≤ 30
	Vinyl Chloride	47-142	≤ 20	37-152	≤ 30
	Surrogates				
	Bromochloromethane	37-137		37-137	
	Bromofluorobenzene	27-137		27-137	
	Bromochlorobenzene	41-133		31-143	

Table 7.2.1-3. Summary of Calibration and QC Procedures for Method SW8010B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8010B	Halogenated volatile organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.1-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8010B	Halogenated volatile organics	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem, then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.1-3. Summary of Calibration and QC Procedures for Method SW8010B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.1-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.1-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
SW8010B	Halogenated volatile organics	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.1-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.1-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.2 Method SW8011-Ethylene Dibromide

Ethylene dibromide (EDB) in water is analyzed using method SW8011. The sample is extracted with hexane. The extract is injected into a GC with a linearized electron capture detector for separation and analysis. The PQL is presented in Table 7.2.2-1.

This method provides for the use of a second GC column of dissimilar phase to resolve compounds of interest from interferences that may occur. When second-column analysis is performed, retention times for the analyte must match those established for each column. Otherwise, the chromatographic peaks are considered interferences, and the analyte is not considered to be present in the sample. Requirements for confirmation of the analyte are described in Section 4.5.2. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.2-2 and 7.2.2-3.

Table 7.2.2-1. PQL for Method SW8011

Parameter/Method	Analyte	Water	
		PQL	Unit
SW8011	EDB	0.1	µg/L

Table 7.2.2-2. QC Acceptance Criteria for Method SW8011

Method	Analyte	Accuracy	Precision
		Water (% R)	Water (% RPD)
SW8011	EDB	85-115	≤ 15

Table 7.2.2-3. Summary of Calibration and QC Procedures for Method SW8011

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8011	EDB	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to the result for EDB for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to the result for EDB for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to the result for EDB in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to the result for EDB for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to the result for EDB in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.2-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to the EDB result for all samples analyzed by the analyst
SW8011	EDB	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to the result for EDB in all samples in the associated analytical batch

Table 7.2.2-3. Summary of Calibration and QC Procedures for Method SW8011

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8011	EDB	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.2-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For EDB in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.2-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.2-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.1-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.3 Method SW8015 (Modified)-Volatile and Extractable Total Petroleum Hydrocarbons

Volatile petroleum hydrocarbon components, such as gasoline, jet fuel, and other low molecular weight petroleum products, are analyzed by the direct purge and trap technique described in method SW5030 followed by a modified approach to method SW8015. Extractable TPH components are analyzed by extraction method SW3520B or SW3550A followed by a modified method SW8015.

For volatile TPH, the sample is placed in the purge and trap sparge vessel and analysis is conducted using a GC equipped with an FID.

Extractable TPH components, such as kerosene, diesel, motor oil, and other high molecular weight extractable petroleum products, are analyzed by method SW3520B (continuous liquid/liquid extraction) for water-based matrices or by method SW3550A (sonication extraction) for soil/sludge matrices. The sample is extracted and analysis is accomplished on a GC equipped with a capillary or megabore column and a FID. PQLs for volatile TPH and extractable TPH are provided in Table 7.2.3-1.

Identification and quantitation of TPH components require more analytical judgment than other GC methods. The TPH chromatograms consist of groups of peaks fall within a noted carbon retention time range (i.e., number of carbon atoms in the molecule). Standard fuel components are used to calibrate the instruments. The total petroleum hydrocarbons results are reported in mg/kg or mg/L based on quantitation of the total area count for the gasoline range organics (i.e., C6-C13) or the diesel range organics (i.e., C13-C28). The retention time window shall be set such that the window encompasses only the C6 through C28 range of organics. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.3-2 and 7.2.3-3.

Table 7.2.3-1. PQLs for Method SW8015 (Modified)

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Petroleum Hydrocarbons	Gasoline	0.1	mg/L	1.0	mg/kg
SW5030/SW8015 (Mod)	Diesel, Jet Fuel	1.0	mg/L	10.0	mg/kg
SW3550A/SW8015 (Mod)					
SW3550A/SW8015 (Mod)					

Table 7.2.3-2. QC Acceptance Criteria for Method SW8015 (Modified)

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8015 (Modified) GRO	TPH-Gasoline	67-136	≤ 30	57-146	≤ 50
	Surrogate: Chlorobenzene	74-138		64-148	
SW8015 (Modified) DRO	TPH-Diesel	61-143	≤ 30	51-153	≤ 50
	TPH-Jet Fuel	61-143	≤ 30	51-153	≤ 50
	Surrogates: Octacosane	26-152		25-162	
	Ortho-Terphenyl	57-132		47-142	

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Table 7.2.3-3. QC Acceptance Criteria for Method SW8015 (Modified)

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20%	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Initial calibration verification	Daily, before sample analysis	All concentration levels of GRO within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All concentration levels within $\pm 15\%$ of initial calibration	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.3-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	Method blank	One per analytical batch	No TPH detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.3-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.3-3. QC Acceptance Criteria for Method SW8015 (Modified)

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.3-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.3-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.3-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.4 Method SW8020A-Aromatic Volatile Organics

Aromatic volatile organics in water and soil samples are prepared using method SW5030 and analyzed using method SW8020A. This method (also known as the BTEX method since the compounds of interest include benzene, toluene, ethylbenzene, and xylene) is a purge and trap GC method. An inert gas is bubbled through a water matrix to transfer the volatile aromatic hydrocarbons from the liquid to the vapor phase. The aromatics are removed from the inert gas by passing the gas through a sorbent trap, which is then backflushed onto a GC column with a PID to separate and quantify the compounds of interest. Soil samples are first extracted. Low concentration contaminated soils may be prepared using method SW5030A. PQLs for method SW8020A are presented in Table 7.2.4-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.4-2 and 7.2.4-3.

Table 7.2.4-1. PQLs for Method SW8020A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Aromatic Volatile Organics SW5030A/SW8020A (W, S)	1,2-DCB	4.0	µg/L	0.004	mg/kg
	1,3-DCB	4.0	µg/L	0.004	mg/kg
	1,4-DCB	3.0	µg/L	0.003	mg/kg
	Benzene	2.0	µg/L	0.002	mg/kg
	Chlorobenzene	2.0	µg/L	0.002	mg/kg
	Ethylbenzene	2.0	µg/L	0.002	mg/kg
	Toluene	2.0	µg/L	0.002	mg/kg
	Xylenes, total	2.0	µg/L	0.002	mg/kg

Table 7.2.4-2. QC Acceptance Criteria for Method SW8020A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8020A	1,2-DCB	61-134	≤ 20	51-144	≤ 30
	1,3-DCB	70-131	≤ 20	60-141	≤ 30
	1,4-DCB	75-126	≤ 20	66-136	≤ 30
	Benzene	75-125	≤ 20	66-135	≤ 30
	Chlorobenzene	75-129	≤ 20	66-139	≤ 30
	Ethylbenzene	71-129	≤ 20	61-139	≤ 30
	Toluene	70-125	≤ 20	60-135	≤ 30
	Xylenes, total	71-133	≤ 20	61-143	≤ 30
	Surrogates:				
	Bromochlorobenzene	46-136		36-146	
	Bromofluorobenzene	48-138		38-148	
	Difluorobenzene	48-138		38-148	
	Fluorobenzene	44-165		34-175	
	1,1,1-Trifluorotoluene	44-165		34-175	

Table 7.2.4-3. Summary of Calibration and QC Procedures for Method SW8020A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8020A	Aromatic volatile organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
SW8020A	Aromatic volatile organics	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.4-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.4-3. Summary of Calibration and QC Procedures for Method SW8020A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.4-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.4-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
SW8020A	Aromatic volatile organics	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.4-2	Correct problem then reextract and analyze sample	For the samples, if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.4-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.5 Method SW8021A-Halogenated Volatile Organics

Halogenated volatile organics in water and soil samples are analyzed using method SW8021A. This method is a purge and trap GC method using preparation method SW5030A. A temperature program is used in the GC to separate the compounds. Detection is achieved by a PID and an electrolytic conductivity detector (HECD) in series. The PQLs for the analytes are presented in Table 7.2.5-1. Requirements for confirmation of analytes are described in Section 4.5.2. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.5-2 and 7.2.5-3.

Table 7.2.5-1. PQLs for Method SW8021A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Halogenated Volatile Organics SW5030A/SW8021A (W, S)	1,1,1,2-Tetrachloroethane	0.10	µg/L	0.01	mg/kg
	1,1,1-TCA	0.30	µg/L	0.01	mg/kg
	1,1,2,2-Tetrachloroethane	0.10	µg/L	0.01	mg/kg
	1,1,2-TCA	0.30	µg/L	0.01	mg/kg
	1,1-DCA	0.70	µg/L	0.01	mg/kg
	1,1-DCE	0.70	µg/L	0.01	mg/kg
	1,2,3-Trichloropropane	4.00	µg/L	0.01	mg/kg
	1,2-DCA	0.30	µg/L	0.01	mg/kg
	1,2-DCB	0.50	µg/L	0.01	mg/kg
	1,2-Dichloropropane	0.10	µg/L	0.01	mg/kg
	1,3-DCB	0.20	µg/L	0.01	mg/kg
	1,4-DCB	0.10	µg/L	0.01	mg/kg
	Benzene	0.10	µg/L	0.01	mg/kg
	Bromobenzene	0.10	µg/L	0.01	mg/kg
	Bromodichloromethane	0.20	µg/L	0.01	mg/kg
	Bromoform	16.0	µg/L	0.01	mg/kg
	Bromomethane	11.00	µg/L	0.01	mg/kg
	Carbon Tetrachloride	0.10	µg/L	0.01	mg/kg
	Chlorobenzene	0.10	µg/L	0.01	mg/kg
	Chloroethane	1.00	µg/L	0.01	mg/kg
	Chloroform	0.20	µg/L	0.01	mg/kg
	Chloromethane	0.30	µg/L	0.01	mg/kg
	Cis-1,2-DCE	0.60	µg/L	0.01	mg/kg
	Cis-1,3-Dichloropropene	0.30	µg/L	0.01	mg/kg
	Dibromochloromethane	0.50	µg/L	0.01	mg/kg
	Dichlorodifluoromethane	0.50	µg/L	0.01	mg/kg
	EDB	8.00	µg/L	0.01	mg/kg
	Ethylbenzene	0.50	µg/L	0.01	mg/kg
	Methylene Chloride	0.20	µg/L	0.01	mg/kg
	TCE	0.20	µg/L	0.01	mg/kg
	Tetrachloroethylene	0.50	µg/L	0.01	mg/kg
	Toluene	0.10	µg/L	0.01	mg/kg
	Trans-1,2-DCE	0.60	µg/L	0.01	mg/kg
	Trans-1,3-Dichloropropene	1.00	µg/L	0.01	mg/kg
	Trichlorofluoromethane	0.30	µg/L	0.01	mg/kg
	Vinyl Chloride	0.40	µg/L	0.01	mg/kg
	Xylenes, Total	0.50	µg/L	0.01	mg/kg

Table 7.2.5-2. QC Acceptance Criteria for Method SW8021A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8021A	1,1,1,2-Tetrachloroethane	75-125	≤ 20	65-125	≤ 30
	1,1,1-TCA	69-134	≤ 20	59-134	≤ 30
	1,1,2,2-Tetrachloroethane	30-166	≤ 20	25-166	≤ 30
	1,1,2-TCA	61-130	≤ 20	51-130	≤ 30
	1,1-DCA	64-127	≤ 20	54-127	≤ 30
	1,1-DCE	53-147	≤ 20	43-147	≤ 30
	1,2,3-Trichloropropane	75-125	≤ 20	65-125	≤ 30
	1,2-DCA	68-137	≤ 20	58-137	≤ 30
	1,2-DCB	61-134	≤ 20	51-134	≤ 30
	1,2-Dichloropropane	73-125	≤ 20	63-125	≤ 30
	1,3-DCB	63-137	≤ 20	53-137	≤ 30
	1,4-DCB	66-135	≤ 20	56-135	≤ 30
	Benzene	75-125	≤ 20	65-125	≤ 30
	Bromobenzene	75-125	≤ 20	65-125	≤ 30
	Bromodichloromethane	61-135	≤ 20	51-135	≤ 30
	Bromoform	58-129	≤ 20	48-129	≤ 30
	Bromomethane	68-125	≤ 20	58-125	≤ 30
	Carbon Tetrachloride	69-139	≤ 20	59-139	≤ 30
	Chlorobenzene	75-129	≤ 20	65-129	≤ 30
	Chloroethane	75-130	≤ 20	65-130	≤ 30
	Chloroform	49-133	≤ 20	39-133	≤ 30
	Chloromethane	59-154	≤ 20	49-154	≤ 30
	Cis-1,2-DCE	75-120	≤ 20	65-125	≤ 30
	Cis-1,3-Dichloropropene	75-130	≤ 20	65-130	≤ 30
	Dibromochloromethane	75-131	≤ 20	65-131	≤ 30
	Dichlorodifluoromethane	68-125	≤ 20	58-125	≤ 30
	EDB	75-131	≤ 20	65-131	≤ 30
	Ethylbenzene	71-129	≤ 20	61-129	≤ 30
	Methylene Chloride	42-176	≤ 20	32-176	≤ 30
	TCE	75-141	≤ 20	65-141	≤ 30
	Tetrachloroethylene	75-142	≤ 20	65-142	≤ 30
	Toluene	70-125	≤ 20	60-125	≤ 30
	Trans-1,2-DCE	75-130	≤ 20	68-130	≤ 30

Table 7.2.5-2. QC Acceptance Criteria for Method SW8021A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8021A	Trans-1,3-Dichloropropene	42-156	≤ 20	32-156	≤ 30
	Trichlorofluoromethane	75-130	≤ 20	69-130	≤ 30
	Vinyl Chloride	47-142	≤ 20	37-142	≤ 30
	Xylenes, Total	71-133	≤ 20	61-133	≤ 30
	Surrogates:				
	1,4-Dichlorobutane	35-135		35-135	
	Bromochlorobenzene	37-137		37-137	

Table 7.2.5-3. Summary of Calibration and QC Procedures for Method SW8021A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8021A	Halogenated volatile organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.5-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8021A	Halogenated volatile organics	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.5-3. Summary of Calibration and QC Procedures for Method SW8021A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8021A		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.5-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.5-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
	Halogenated volatile organics	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.5-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if;(1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.5-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.6 Method SW8070-Nitrosamines

Select nitrosamines in water and soil samples are analyzed using method SW8070. The sample is extracted and analyzed by gas chromatography. PQLs for method SW8070 are presented in Table 7.2.6-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.6-2 and 7.2.6-3.

Table 7.2.6-1. PQLs for Method SW8070

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Nitrosamines/SW8070	N-Nitrosodi-n-propylamine	2.0	µg/L	4.0	mg/kg
	N-Nitrosodimethylamine	0.50	µg/L	1.0	mg/kg
	N-Nitrosodiphenylamine	3.0	µg/L	6.0	mg/kg

Table 7.2.6-2. QC Acceptance Criteria for Method SW8070

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8070	N-Nitrosodi-n-propylamine	45-146	≤ 30	35-146	≤ 50
	N-Nitrosodimethylamine	25-125	≤ 30	25-135	≤ 50
	N-Nitrosodiphenylamine	25-139	≤ 30	25-149	≤ 50
	Surrogates ^a :				

- a. Use an analyte and its LCS limit from the method that is not expected to be present in the sample as the surrogate.

Table 7.2.6-3. Summary of Calibration and QC Procedures for Method SW8070

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8070	Nitrosamines	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.6-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8070	Nitrosamines	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.6-3. Summary of Calibration and QC Procedures for Method SW8070

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.6-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.6-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
SW8070	Nitrosamines	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.6-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.6-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.7 Method SW8080A-Organochlorine Pesticides and Polychlorinated Biphenyls

Organochlorine pesticides and PCBs in water and soil samples are analyzed using method SW8080A. This analytical method involves extraction of water samples using a separatory funnel (method SW3510B). Extraction of solid samples is accomplished using ultrasonic extraction (method SW3550A) procedures. The pesticides and PCBs are separated and quantified by GC using electron capture detection. PQLs for this method are presented in Table 7.2.7-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.7-2 and 7.2.7-3.

Table 7.2.7-1. PQLs for Method SW8080A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organochlorine Pesticides and PCBs SW3510B/SW8080A (W) SW3550A/SW8080A (S)	Aldrin	0.04	µg/L	0.003	mg/kg
	α-BHC	0.03	µg/L	0.002	mg/kg
	β-BHC	0.06	µg/L	0.004	mg/kg
	δ-BHC	0.09	µg/L	0.006	mg/kg
	γ-BHC (Lindane)	0.04	µg/L	0.003	mg/kg
	Chlordane (technical)	0.14	µg/L	0.009	mg/kg
	4,4'-DDD	0.11	µg/L	0.007	mg/kg
	4,4'-DDE	0.04	µg/L	0.003	mg/kg
	4,4'-DDT	0.12	µg/L	0.008	mg/kg
	Dieldrin	0.02	µg/L	0.01	mg/kg
	Endosulfan I	0.14	µg/L	0.009	mg/kg
	Endosulfan II	0.04	µg/L	0.003	mg/kg
	Endosulfan Sulfate	0.66	µg/L	0.04	mg/kg
	Endrin	0.06	µg/L	0.004	mg/kg
	Endrin Aldehyde	0.23	µg/L	0.02	mg/kg
	Heptachlor	0.03	µg/L	0.002	mg/kg
	Heptachlor Epoxide	0.83	µg/L	0.06	mg/kg
	Methoxychlor	1.76	µg/L	0.1	mg/kg
	Toxaphene	2.4	µg/L	0.2	mg/kg
	PCB-1016	1.0	µg/L	1.0	mg/kg
	PCB-1221	1.0	µg/L	1.0	mg/kg
	PCB-1232	1.0	µg/L	1.0	mg/kg
	PCB-1242	1.0	µg/L	1.0	mg/kg
	PCB-1248	1.0	µg/L	1.0	mg/kg
	PCB-1254	1.0	µg/L	1.0	mg/kg
	PCB-1260	1.0	µg/L	1.0	mg/kg

Table 7.2.7-2. QC Acceptance Criteria for Method SW8080A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8080A	Aldrin	47-125	≤ 30	37-135	≤ 50
	α-BHC	75-125	≤ 30	65-135	≤ 50
	β-BHC	51-125	≤ 30	41-133	≤ 50
	δ-BHC	75-126	≤ 30	65-136	≤ 50
	γ-BHC (Lindane)	73-125	≤ 30	63-135	≤ 50
	Chlordane (technical)	45-125	≤ 30	35-135	≤ 50
	4,4'-DDD	48-136	≤ 30	38-146	≤ 50
	4,4'-DDE	45-139	≤ 30	35-149	≤ 50
	4,4'-DDT	34-143	≤ 30	25-153	≤ 50
	Dieldrin	42-132	≤ 30	32-142	≤ 50
	Endosulfan I	49-143	≤ 30	39-153	≤ 50
	Endosulfan II	75-159	≤ 30	65-169	≤ 50
	Endosulfan Sulfate	46-141	≤ 30	36-151	≤ 50
	Endrin	43-134	≤ 30	33-144	≤ 50
	Endrin Aldehyde	75-150	≤ 30	65-160	≤ 50
	Heptachlor	45-128	≤ 30	35-138	≤ 50
	Heptachlor Epoxide	53-134	≤ 30	43-144	≤ 50
	Methoxychlor	73-142	≤ 30	63-152	≤ 50
	Toxaphene	41-126	≤ 30	31-136	≤ 50
	PCB-1016	54-125	≤ 30	44-135	≤ 50
	PCB-1221	30-175	≤ 30	25-175	≤ 50
	PCB-1232	39-150	≤ 30	29-160	≤ 50
	PCB-1242	39-150	≤ 30	29-160	≤ 50
	PCB-1248	38-158	≤ 30	28-168	≤ 50
	PCB-1254	29-131	≤ 30	25-141	≤ 50
	PCB-1260	41-126	≤ 30	31-136	≤ 50
	Surrogates:				
	DCBP	34-133		34-133	
	TCMX	45-120		45-120	

Table 7.2.7-3. Summary of Calibration and QC Procedures for Method SW8080A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8080A	Organo-chlorine pesticides and PCBs	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and verification	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
SW8080A	Organo-chlorine pesticides and PCBs	Breakdown check (Endrin and DDT)	Daily prior to analysis of samples	Degradation $\leq 20\%$	Repeat breakdown check	Apply J to all positive DDT, DDE, DDD, endrin, endrin ketone and endrin aldehyde results; apply R to the analytes listed above if minimum frequency is not met
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.7-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

Table 7.2.7-3. Summary of Calibration and QC Procedures for Method SW8080A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8080A	Organo-chlorine pesticides and PCBs	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.7-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.7-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.7-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.7-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed

Table 7.2.7-3. Summary of Calibration and QC Procedures for Method SW8080A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8080A	Organo-chlorine pesticides and PCBs	Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.8 Method SW8081-Organochlorine Pesticides and Polychlorinated Biphenyls

Organochlorine pesticides and PCBs in water and soil samples are analyzed using method SW8081. This analytical method involves extraction of water samples using a separator funnel (method SW3510B). Extraction of solid samples is accomplished with ultrasonic extraction (method SW3550A) procedures. The pesticides and PCBs are separated and quantified by GC using electron capture detection. Practical quantitation limits (PQLs) for this method are presented in Table 7.2.8-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.8-2 and 7.2.8-3.

Table 7.2.8-1. PQLs for Method SW8081

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organochlorine Pesticides and PCBs SW3510B/SW8081 (W) SW3550A/SW8081 (S)	α -BHC	0.35	$\mu\text{g/L}$	0.019	mg/kg
	β -BHC	0.23	$\mu\text{g/L}$	0.033	mg/kg
	δ -BHC	0.24	$\mu\text{g/L}$	0.011	mg/kg
	γ -BHC (Lindane)	0.25	$\mu\text{g/L}$	0.020	mg/kg
	α -Chlordane	0.80	$\mu\text{g/L}$	0.015	mg/kg
	γ -Chlordane	0.37	$\mu\text{g/L}$	0.015	mg/kg
	4,4'-DDD	0.50	$\mu\text{g/L}$	0.042	mg/kg
	4,4'-DDE	0.58	$\mu\text{g/L}$	0.025	mg/kg
	4,4'-DDT	0.81	$\mu\text{g/L}$	0.036	mg/kg
	Aldrin	0.34	$\mu\text{g/L}$	0.022	mg/kg
	Dieldrin	0.44	$\mu\text{g/L}$	0.035	mg/kg
	Endosulfan I	0.30	$\mu\text{g/L}$	0.021	mg/kg
	Endosulfan II	0.40	$\mu\text{g/L}$	0.024	mg/kg
	Endosulfan Sulfate	0.35	$\mu\text{g/L}$	0.036	mg/kg
	Endrin	0.39	$\mu\text{g/L}$	0.036	mg/kg
	Endrin Aldehyde	0.50	$\mu\text{g/L}$	0.016	mg/kg
	Heptachlor	0.40	$\mu\text{g/L}$	0.020	mg/kg
	Heptachlor Epoxide	0.32	$\mu\text{g/L}$	0.021	mg/kg
	Methoxychlor	0.86	$\mu\text{g/L}$	0.057	mg/kg
	PCB-1016	1.00	$\mu\text{g/L}$	0.70	mg/kg
	PCB-1221	1.00	$\mu\text{g/L}$	0.70	mg/kg
	PCB-1232	1.00	$\mu\text{g/L}$	0.70	mg/kg
	PCB-1242	1.00	$\mu\text{g/L}$	0.70	mg/kg
	PCB-1248	1.00	$\mu\text{g/L}$	0.70	mg/kg
	PCB-1254	1.00	$\mu\text{g/L}$	0.70	mg/kg
	PCB-1260	1.00	$\mu\text{g/L}$	0.70	mg/kg
	Toxaphene	0.50	$\mu\text{g/L}$	0.57	mg/kg

Table 7.2.8-2. QC Acceptance Criteria for Method SW8081

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8081	α -BHC	75-125	≤ 30	65-135	≤ 50
	β -BHC	51-125	≤ 30	41-133	≤ 50
	δ -BHC	75-126	≤ 30	65-136	≤ 50
	γ -BHC (Lindane)	73-125	≤ 30	63-130	≤ 50
	α -Chlordane	41-125	≤ 30	31-135	≤ 50
	γ -Chlordane	41-125	≤ 30	31-133	≤ 50
	4,4-DDD	48-136	≤ 30	38-146	≤ 50
	4,4-DDE	45-139	≤ 30	35-149	≤ 50
	4,4-DDT	34-143	≤ 30	25-153	≤ 50
	Aldrin	47-125	≤ 30	37-126	≤ 50
	Dieldrin	42-132	≤ 30	32-142	≤ 50
	Endosulfan I	49-143	≤ 30	39-153	≤ 50
	Endosulfan II	75-159	≤ 30	65-169	≤ 50
	Endosulfan Sulfate	46-141	≤ 30	36-151	≤ 50
	Endrin	43-134	≤ 30	33-144	≤ 50
	Endrin Aldehyde	75-150	≤ 30	65-160	≤ 50
	Heptachlor	45-128	≤ 30	35-138	≤ 50
	Heptachlor Epoxide	53-134	≤ 30	43-144	≤ 50
	Methoxychlor	73-142	≤ 30	63-152	≤ 50
	PCB-1016	54-125	≤ 30	44-127	≤ 50
	PCB-1221	41-126	≤ 30	31-136	≤ 50
	PCB-1232	41-126	≤ 30	31-136	≤ 50
	PCB-1242	39-150	≤ 30	29-160	≤ 50
	PCB-1248	41-126	≤ 30	31-136	≤ 50
	PCB-1254	29-131	≤ 30	25-141	≤ 50
	PCB-1260	41-126	≤ 30	31-136	≤ 50
	Toxaphene	41-126	≤ 30	31-136	≤ 50
	Surrogates:				
	DCBP	34-133		25-143	
	TCMX	45-125		35-135	

Table 7.2.8-3 Summary of Calibration and QC Procedures for Method SW8081

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8081	Organo-chlorine pesticides and PCBs	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 20 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
SW8081	Organo-chlorine pesticides and PCBs	Breakdown check (Endrin and DDT)	Daily prior to analysis of samples	Degradation $\leq 15\%$	Repeat breakdown check	Apply J to all positive DDT, DDE, DDD, endrin, endrin ketone and endrin aldehyde results; apply R to the analytes listed above if minimum frequency is not met
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.8-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

Table 7.2.8-3 Summary of Calibration and QC Procedures for Method SW8081

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.8-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
SW8081	Organo-chlorine pesticides and PCBs	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.8-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.8-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.8-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
SW8081	Organo-chlorine pesticides and PCBs	Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.9 Method SW8140-Organophosphorus Pesticides

Method SW8140 is a GC method used to determine the concentrations of various organophosphorus pesticides. This analytical method involves extraction of water samples using a separatory funnel (method SW3510B). Extraction of solid samples is accomplished by ultrasonic extraction (method SW3550A) procedures. An aliquot of the extract is injected into a GC, and compounds in the GC effluent are detected with a flame photometric or nitrogen-phosphorus detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for these pesticides are presented in Table 7.2.9-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.9-2 and 7.2.9-3.

Table 7.2.9-1. PQLs for Method SW8140

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organophosphorus Pesticides SW3510B/SW8140 (W) SW3550A/SW8140 (S)	Azinphos Methyl	15.0	µg/L	1.0	mg/kg
	Bolstar	1.5	µg/L	0.1	mg/kg
	Chlorpyrifos	3.0	µg/L	0.2	mg/kg
	Coumaphos	15.0	µg/L	1.0	mg/kg
	Demeton-o	2.5	µg/L	0.2	mg/kg
	Demeton-s	2.5	µg/L	0.2	mg/kg
	Diazinon	6.0	µg/L	0.4	mg/kg
	Dichlorovos	10.0	µg/L	0.7	mg/kg
	Disulfoton	2.0	µg/L	0.1	mg/kg
	Ethoprop	2.5	µg/L	0.2	mg/kg
	Fensulfothion	15.0	µg/L	1.0	mg/kg
	Fenthion	1.0	µg/L	0.1	mg/kg
	Merphos	2.5	µg/L	0.2	mg/kg
	Mevinphos	3.0	µg/L	0.2	mg/kg
	Naled	1.0	µg/L	0.1	mg/kg
	Parathion Methyl	0.3	µg/L	0.02	mg/kg
	Phorate	1.5	µg/L	0.1	mg/kg
	Ronnel	3.0	µg/L	0.2	mg/kg
	Stirophos	50.0	µg/L	2.4	mg/kg
	Tokuthion	5.0	µg/L	0.4	mg/kg
	Trichloronate	1.5	µg/L	0.1	mg/kg

Table 7.2.9-2. QC Acceptance Criteria for Method SW8140

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8140	Azinphos Methyl	50-150	≤ 30	40-160	≤ 50
	Bolstar	46-125	≤ 30	36-135	≤ 50
	Chlorpyrifos	75-125	≤ 30	65-135	≤ 50
	Coumaphos	71-147	≤ 30	61-157	≤ 50
	Demeton-o	50-150	≤ 30	40-160	≤ 50
	Demeton-s	50-150	≤ 30	40-160	≤ 50
	Diazinon	47-149	≤ 30	37-159	≤ 50
	Dichlorovos	49-125	≤ 30	39-135	≤ 50
	Disulfoton	50-150	≤ 30	40-160	≤ 50
	Ethoprop	75-125	≤ 30	65-135	≤ 50
	Fensulfothion	43-145	≤ 30	33-155	≤ 50
	Fenthion	25-125	≤ 30	25-130	≤ 50
	Merphos	75-144	≤ 30	65-154	≤ 50
	Mevinphos	33-125	≤ 30	25-135	≤ 50
	Naled	54-125	≤ 30	44-135	≤ 50
	Parathion Methyl	45-130	≤ 30	35-140	≤ 50
	Phorate	50-150	≤ 30	40-160	≤ 50
	Ronnel	75-116	≤ 30	65-135	≤ 50
	Stirophos	48-125	≤ 30	38-135	≤ 50
	Tokuthion	44-125	≤ 30	34-135	≤ 50
	Trichloronate	49-161	≤ 30	39-171	≤ 50
	Surrogates^a:				

- a. Use an analyte and its LCS limit from the method that is not expected to be present in the sample as the surrogate.

Table 7.2.9-3. Summary of Calibration and QC Procedures for Method SW8140

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8140	Organophosphorus pesticides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.9-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8140	Organophosphorus pesticides	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.9-3. Summary of Calibration and QC Procedures for Method SW8140

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8140	Organophosphorus pesticides	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.9-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.9-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.9-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
SW8140	Organophosphorus pesticides	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.9-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.10 Method SW8141A-Organophosphorus Pesticides

Method SW8141A is a GC method used to determine the concentrations of various organophosphorus pesticides. This analytical method involves extraction of water samples using a separatory funnel (method SW3510B). Extraction of solid samples is accomplished using one of the Soxhlet extraction (method SW3540B or SW3541) procedures. An aliquot of the extract is injected into a GC, and compounds in the GC effluent are detected with a flame photometric or nitrogen-phosphorus detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for these pesticides are presented in Table 7.2.10-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.10-2 and 7.2.10-3.

Table 7.2.10-1. PQLs for Method SW8141A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organophosphorus Pesticides SW3510B/SW8141A (W) SW3540A/SW8141A (S) SW3541A/SW8141A (S)	Azinphos Methyl	1.0	µg/L	0.05	mg/kg
	Bolstar	0.7	µg/L	0.04	mg/kg
	Chlorpyrifos	0.7	µg/L	0.05	mg/kg
	Coumaphos	2.0	µg/L	0.10	mg/kg
	Demeton-o	1.2	µg/L	0.06	mg/kg
	Demeton-s	1.2	µg/L	0.06	mg/kg
	Diazinon	2.0	µg/L	0.10	mg/kg
	Dichlorovos	8.0	µg/L	0.40	mg/kg
	Disulfoton	0.7	µg/L	0.04	mg/kg
	Ethoprop	2.0	µg/L	0.10	mg/kg
	Fensulfothion	0.8	µg/L	0.04	mg/kg
	Fenthion	0.8	µg/L	0.05	mg/kg
	Merphos	2.0	µg/L	0.10	mg/kg
	Mevinphos	5.0	µg/L	0.25	mg/kg
	Naled	5.0	µg/L	0.25	mg/kg
	Parathion Methyl	1.2	µg/L	0.06	mg/kg
	Phorate	0.4	µg/L	0.02	mg/kg
	Ronnel	0.7	µg/L	0.04	mg/kg
	Stirophos	8.0	µg/L	0.40	mg/kg
	Tokuthion	0.7	µg/L	0.06	mg/kg
	Trichloronate	8.0	µg/L	0.40	mg/kg

Table 7.2.10-2. QC Acceptance Criteria for Method SW8141A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8141A	Azinphos Methyl	50-150	≤ 30	40-160	≤ 50
	Bolstar	46-125	≤ 30	36-135	≤ 50
	Chlorpyrifos	75-125	≤ 30	65-135	≤ 50
	Coumaphos	71-147	≤ 30	61-157	≤ 50
	Demeton-o	50-150	≤ 30	40-160	≤ 50
	Demeton-s	50-150	≤ 30	40-160	≤ 50
	Diazinon	47-149	≤ 30	37-159	≤ 50
	Dichlorovos	49-125	≤ 30	39-135	≤ 50
	Disulfoton	50-150	≤ 30	40-160	≤ 50
	Ethoprop	75-125	≤ 30	65-135	≤ 50
	Fensulfothion	43-145	≤ 30	33-155	≤ 50
	Fenthion	25-125	≤ 30	25-135	≤ 50
	Merphos	75-144	≤ 30	65-154	≤ 50
	Mevinphos	33-125	≤ 30	25-135	≤ 50
	Naled	54-125	≤ 30	44-135	≤ 50
	Parathion Methyl	45-130	≤ 30	35-140	≤ 50
	Phorate	50-150	≤ 30	40-160	≤ 50
	Ronnel	75-125	≤ 30	65-135	≤ 50
	Stirophos	48-125	≤ 30	38-135	≤ 50
	Tokuthion	44-125	≤ 30	34-135	≤ 50
	Trichloronate	49-161	≤ 30	39-171	≤ 50
	Surrogates:				
	Tributyl Phosphate	67-136	≤ 30	67-136	≤ 50
	Triphenyl Phosphate	65-134	≤ 30	65-134	≤ 50

Table 7.2.10-3. Summary of Calibration and QC Procedures for Method SW8141A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8141A	Organophosphorus pesticides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.10-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8141A	Organophosphorus pesticides	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.10-3. Summary of Calibration and QC Procedures for Method SW8141A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.10-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
SW8141A	Organophosphorus pesticides	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.10-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects if any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.10-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.10-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
SW8141A	Organophosphorus pesticides	Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.11 Method SW8150B-Chlorinated Herbicides

Method SW8150B is a GC method for determining selected chlorinated acid herbicides. The esters are hydrolyzed and extraneous organic material is removed by a solvent wash. After acidification, the acids are extracted with solvent and converted to esthers. The esters are determined by GC employing an electron capture detector. The results are reported as the acid equivalents. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for herbicides are presented in Table 7.2.11-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.11-2 and 7.2.11-3.

Table 7.2.11-1. PQLs for Method SW8150B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Chlorinated Phenoxy Acid Herbicides SW8150B (W, S)	2,4-D	12.0	µg/L	0.8	mg/kg
	2,4-DB	9.0	µg/L	0.6	mg/kg
	2,4,5-T	2.0	µg/L	0.1	mg/kg
	2,4,5-TP	1.7	µg/L	0.1	mg/kg
	Dalapon	60.0	µg/L	4.0	mg/kg
	Dicamba	2.7	µg/L	0.2	mg/kg
	Dichloroprop	6.5	µg/L	0.5	mg/kg
	Dinoseb	0.7	µg/L	0.05	mg/kg
	MCPA	2,500.0	µg/L	170.0	mg/kg
	MCPP	1,900.0	µg/L	130.0	mg/kg

Table 7.2.11-2. QC Acceptance Criteria for Method SW8150B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8150B	2,4-D	65-125	≤ 30	55-135	≤ 50
	2,4-DB	65-125	≤ 30	55-135	≤ 50
	2,4,5-T	71-125	≤ 30	61-135	≤ 50
	2,4,5-TP	75-125	≤ 30	65-135	≤ 50
	Dalapon	70-125	≤ 30	60-135	≤ 50
	Dicamba	59-125	≤ 30	49-135	≤ 50
	Dichloroprop	63-125	≤ 30	53-135	≤ 50
	Dinoseb	72-125	≤ 30	62-135	≤ 50
	MCPA	64-125	≤ 30	54-135	≤ 50
	MCPP	75-125	≤ 30	65-135	≤ 50
	<i>Surrogate:</i>				
	2,4-Dichlorophenylacetic acid	61-136	≤ 30	51-146	≤ 50

Table 7.2.11-3. Summary of Calibration and QC Procedures for Method SW8150B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8150B	Chlorinated Herbicides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.11-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8150B	Chlorinated Herbicides	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.11-3. Summary of Calibration and QC Procedures for Method SW8150B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8150B	Chlorinated Herbicides	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.11-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.11-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.11-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
SW8150B	Chlorinated Herbicides	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.11-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.12 Method SW8151-Chlorinated Herbicides

Method SW8151 is a capillary GC method for determining selected chlorinated acid herbicides and related compounds. Samples are extracted then esterified. The esters are determined by GC employing an electron capture detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for herbicides are presented in Table 7.2.12-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.12-2 and 7.2.12-3.

Table 7.2.12-1. PQLs for Method SW8151

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Chlorinated Phenoxy Acid Herbicides SW8151 (W, S)	2,4-D	20.0	µg/L	0.01	mg/kg
	2,4-DB	80.0	µg/L	10.0	mg/kg
	2,4,5-T	0.80	µg/L	0.5	mg/kg
	2,4,5-TP	0.75	µg/L	0.3	mg/kg
	Dalapon	13.0	µg/L	0.01	mg/kg
	Dicamba	0.81	µg/L	0.5	mg/kg
	Dichloroprop	2.6	µg/L	2.0	mg/kg
	Dinoseb	1.9	µg/L	2.7	mg/kg
	MCPA	0.56	µg/L	6.6	mg/kg
	MCP	0.9	µg/L	4.3	mg/kg

Table 7.2.12-2. QC Acceptance Criteria for Method SW8151

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8151	2,4-D	65-125	≤ 30	55-135	≤ 50
	2,4-DB	65-125	≤ 30	55-135	≤ 50
	2,4,5-T	71-125	≤ 30	61-135	≤ 50
	2,4,5-TP	75-125	≤ 30	65-135	≤ 50
	Dalapon	70-125	≤ 30	60-135	≤ 50
	Dicamba	59-125	≤ 30	49-135	≤ 50
	Dichloroprop	63-125	≤ 30	53-135	≤ 50
	Dinoseb	72-125	≤ 30	62-135	≤ 50
	MCPA	64-125	≤ 30	54-135	≤ 50
	MCP	75-125	≤ 30	65-135	≤ 50
	<i>Surrogate:</i> 2,4-Dichlorophenylacetic acid	61-136	≤ 30	51-146	≤ 50

Table 7.2.12-3. Summary of Calibration and QC Procedures for Method SW8151

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8151	Chlorinated Herbicides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.12-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8151	Chlorinated Herbicides	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.12-3. Summary of Calibration and QC Procedures for Method SW8151

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.12-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.12-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
SW8151	Chlorinated Herbicides	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.12-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.12-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.13 Method SW8240B-Volatile Organics

Volatile (or purgeable) organics in water and soil samples are analyzed using method SW8240B. This method uses a GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030A). An inert gas is bubbled through the water samples (or a soil-water slurry for soil samples) to transfer the purgeable organic compounds from the liquid to vapor phase. Soil samples with higher contaminant levels are extracted before purging. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a capillary GC column where they are separated and then detected with a mass spectrometer. The analytes detected and PQLs for this method are listed in Table 7.2.13-1.

Calibration—The mass spectrometer is tuned daily to give an acceptable spectrum for bromofluorobenzene (BFB). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- 50-15 percent to 40 percent of mass 95
- 75-30 percent to 60 percent of mass 95
- 95-base peak, 100 percent relative abundance
- 96-5 percent to 9 percent of mass 95
- 173-0 percent to less than 2 percent of mass 174
- 174-greater than 50 percent of mass 95
- 175-5 percent to 9 percent of mass 174
- 176-greater than 95 percent, but less than 101 percent of mass 174
- 177-5 percent to 9 percent of mass 176

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS that is added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.13-2 and 7.2.13-3.

Table 7.2.13-1. PQLs for Method SW8240B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
VOCs SW5030A/SW8240B (W, S)	1,1,1-TCA	5.0	µg/L	0.005	mg/kg
	1,1,2,2-Tetrachloroethane	5.0	µg/L	0.005	mg/kg
	1,1,2-TCA	5.0	µg/L	0.005	mg/kg
	1,1-DCA	5.0	µg/L	0.005	mg/kg
	1,1-DCE	5.0	µg/L	0.005	mg/kg
	1,2,3-Trichloropropane	5.0	µg/L	0.05	mg/kg
	1,2-DCA	5.0	µg/L	0.005	mg/kg
	1,2-Dichloropropane	5.0	µg/L	0.005	mg/kg
	2-Butanone	100.0	µg/L	0.1	mg/kg
	2-Chloroethyl Vinyl Ether	10.0	µg/L	0.01	mg/kg
	2-Hexanone	50.0	µg/L	0.05	mg/kg
	4-Methyl-2-Pentanone	50.0	µg/L	0.05	mg/kg
	Acetone	100.0	µg/L	0.1	mg/kg
	Benzene	5.0	µg/L	0.005	mg/kg
	Bromodichloromethane	5.0	µg/L	0.005	mg/kg
	Bromoform	5.0	µg/L	0.005	mg/kg
	Bromomethane	10.0	µg/L	0.01	mg/kg
	Carbon Disulfide	5.0	µg/L	0.005	mg/kg
	Carbon Tetrachloride	5.0	µg/L	0.005	mg/kg
	Chlorobenzene	5.0	µg/L	0.005	mg/kg
	Chloroethane	10.0	µg/L	0.01	mg/kg
	Chloroform	5.0	µg/L	0.005	mg/kg
	Chloromethane	10.0	µg/L	0.01	mg/kg
	Cis-1,2-DCE	5.0	µg/L	0.005	mg/kg
	Cis-1,3-Dichloropropene	5.0	µg/L	0.005	mg/kg
	Dibromochloromethane	5.0	µg/L	0.005	mg/kg
	Ethylbenzene	5.0	µg/L	0.005	mg/kg
	Methylene Chloride	5.0	µg/L	0.005	mg/kg
	Styrene	5.0	µg/L	0.005	mg/kg
	TCE	5.0	µg/L	0.005	mg/kg
	Tetrachloroethylene	5.0	µg/L	0.005	mg/kg
	Toluene	5.0	µg/L	0.005	mg/kg
	Trans-1,2-DCE	5.0	µg/L	0.005	mg/kg
	Trans-1,3-Dichloropropene	5.0	µg/L	0.005	mg/kg
	Vinyl Acetate	50.0	µg/L	0.05	mg/kg
	Vinyl Chloride	10.0	µg/L	0.01	mg/kg
	Xylenes (total all isomers)	5.0	µg/L	0.005	mg/kg

Table 7.2.13-2. QC Acceptance Criteria for Method SW8240B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8240B	1,1,1-TCA	68-135	≤ 20	58-145	≤ 30
	1,1,2,2-Tetrachloroethane	55-138	≤ 20	45-148	≤ 30
	1,1,2-TCA	70-141	≤ 20	60-151	≤ 30
	1,1-DCA	62-141	≤ 20	52-151	≤ 30
	1,1-DCE	54-128	≤ 20	44-138	≤ 30
	1,2,3-Trichloropropane	75-140	≤ 20	66-150	≤ 30
	1,2-DCA	68-135	≤ 20	58-145	≤ 30
	1,2-Dichloropropane	75-132	≤ 20	66-142	≤ 30
	2-Butanone	50-163	≤ 20	40-173	≤ 30
	2-Chloroethyl Vinyl Ether	25-175	≤ 20	25-175	≤ 30
	2-Hexanone	47-165	≤ 20	37-175	≤ 30
	4-Methyl-2-Pentanone	75-125	≤ 20	67-135	≤ 30
	Acetone	43-165	≤ 20	33-175	≤ 30
	Benzene	51-139	≤ 20	41-149	≤ 30
	Bromodichloromethane	68-135	≤ 20	58-145	≤ 30
	Bromoform	67-129	≤ 20	57-139	≤ 30
	Bromomethane	49-125	≤ 20	39-135	≤ 30
	Carbon Disulfide	75-125	≤ 20	65-135	≤ 30
	Carbon Tetrachloride	67-125	≤ 20	57-135	≤ 30
	Chlorobenzene	59-140	≤ 20	49-150	≤ 30
	Dibromochloromethane	64-125	≤ 20	54-135	≤ 30
	Chloroethane	62-125	≤ 20	52-135	≤ 30
	Chloroform	65-129	≤ 20	55-139	≤ 30
	Chloromethane	38-125	≤ 20	28-135	≤ 30
	Cis-1,2-DCE	70-131	≤ 20	60-141	≤ 30
	Cis-1,3-Dichloropropene	70-125	≤ 20	60-135	≤ 30
	Ethylbenzene	59-140	≤ 20	49-150	≤ 30
	Methylene Chloride	55-126	≤ 20	45-136	≤ 30
	Styrene	71-133	≤ 20	61-143	≤ 30
	TCE	67-137	≤ 20	57-147	≤ 30
	Tetrachloroethylene	67-131	≤ 20	57-141	≤ 30
	Toluene	61-137	≤ 20	51-147	≤ 30
	Trans-1,2-DCE	61-138	≤ 20	51-148	≤ 30
	Trans-1,3-Dichloropropene	42-154	≤ 20	25-164	≤ 30
	Vinyl Acetate	75-125	≤ 20	65-135	≤ 30
	Vinyl Chloride	31-125	≤ 20	25-135	≤ 30
	Xylenes, Total	68-133	≤ 20	58-143	≤ 30

Table 7.2.13-2. QC Acceptance Criteria for Method SW8240B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8240B (Concluded)	Surrogates:				
	Toluene-D8	88-110		88-110	
	4-Bromofluorobenzene	86-115		86-115	
	1,2-DCA-D4	79-118		79-118	

Table 7.2.13-3. Summary of Calibration and QC Procedures for Method SW8240B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8240B	Volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average $RF \geq 0.30^C$; and %RSD for all calibration analytes $\leq 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average $RF \geq 0.30^C$; and CCCs $< 20\%$ drift; and all calibration analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.13-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.13)	Retune instrument and verify	Apply R to all results for all samples associated with the tune
SW8240B	Volatile Organics	ISs	Immediately after or during data acquisition of calibration check standard	Retention time ± 30 seconds; EICP area within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometry or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply R to all results for specific analytes for all samples associated with the IS

Table 7.2.13-3. Summary of Calibration and QC Procedures for Method SW8240B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8240B	Volatile Organics	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.13-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.13-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.13-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3) MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.13-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed

Table 7.2.13-3. Summary of Calibration and QC Procedures for Method SW8240B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
- c. Except > 0.10 for bromoform

7.2.14 Method SW8260A-Volatile Organics

Volatile (or purgeable) organics in water and soil samples are analyzed using method SW8260A. This method uses a capillary column GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030A). An inert gas is bubbled through the water samples (or a soil-water slurry for soil samples) to transfer the purgeable organic compounds from the liquid to vapor phase. Soil samples with higher contaminant levels are extracted using methanol before purging. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a capillary GC column where they are separated and then detected with a mass spectrometer. The analytes detected and PQLs for this method are listed in Table 7.2.14-1.

Calibration—The mass spectrometer is tuned daily to give an acceptable spectrum for BFB. The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- 50-15 percent to 40 percent of mass 95
- 75-30 percent to 60 percent of mass 95
- 95-base peak, 100 percent relative abundance
- 96-5 percent to 9 percent of mass 95
- 173-less than 2 percent of mass 174
- 174-greater than 50 percent of mass 95
- 175-5 percent to 9 percent of mass 174
- 176-greater than 95 percent, but less than 101 percent of mass 174
- 177-5 percent to 9 percent of mass 176

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.14-2 and 7.2.14-3.

Table 7.2.14-1. PQLs for Method SW8260A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
VOCs SW5030A/SW8260A (W, S)	1,1,1,2-Tetrachloroethane	0.5	µg/L	0.003	mg/kg
	1,1,1-TCA	0.8	µg/L	0.004	mg/kg
	1,1,2,2-Tetrachloroethane	0.4	µg/L	0.002	mg/kg
	1,1,2-TCA	1.0	µg/L	0.005	mg/kg
	1,1-DCA	0.4	µg/L	0.002	mg/kg
	1,1-DCE	1.2	µg/L	0.006	mg/kg
	1,1-Dichloropropene	1.0	µg/L	0.005	mg/kg
	1,2,3-Trichlorobenzene	0.3	µg/L	0.002	mg/kg
	1,2,3-Trichloropropane	3.2	µg/L	0.02	mg/kg
	1,2,4-Trichlorobenzene	0.4	µg/L	0.002	mg/kg
	1,2,4-Trimethylbenzene	1.3	µg/L	0.007	mg/kg
	1,2-DCA	0.6	µg/L	0.003	mg/kg
	1,2-DCB	0.3	µg/L	0.002	mg/kg
	1,2-Dibromo-3-chloropropane	2.6	µg/L	0.01	mg/kg
	1,2-Dichloropropane	0.4	µg/L	0.002	mg/kg
	1,2-EDB	0.6	µg/L	0.003	mg/kg
	1,3,5-Trimethylbenzene	0.5	µg/L	0.003	mg/kg
	1,3-DCB	1.2	µg/L	0.006	mg/kg
	1,3-Dichloropropane	0.4	µg/L	0.002	mg/kg
	1,4-DCB	0.3	µg/L	0.002	mg/kg
	1-Chlorohexane	0.5	µg/L	0.003	mg/kg
	2,2-Dichloropropane	3.5	µg/L	0.02	mg/kg
	2-Chlorotoluene	0.4	µg/L	0.002	mg/kg
	4-Chlorotoluene	0.6	µg/L	0.003	mg/kg
	Benzene	0.4	µg/L	0.002	mg/kg
	Bromobenzene	0.3	µg/L	0.002	mg/kg
	Bromochloromethane	0.4	µg/L	0.002	mg/kg
	Bromodichloromethane	0.8	µg/L	0.004	mg/kg
	Bromoform	1.2	µg/L	0.006	mg/kg
	Bromomethane	1.1	µg/L	0.005	mg/kg
	Carbon tetrachloride	2.1	µg/L	0.01	mg/kg
	Chlorobenzene	0.4	µg/L	0.002	mg/kg
	Chloroethane	1.0	µg/L	0.005	mg/kg
	Chloroform	0.3	µg/L	0.002	mg/kg
	Chloromethane	1.3	µg/L	0.007	mg/kg

Table 7.2.14-1. PQLs for Method SW8260A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
VOCs SW5030A/SW8260A (W, S) (concluded)	Cis-1,2-DCE	1.2	µg/L	0.006	mg/kg
	Cis-1,3-Dichloropropene	1.0	µg/L	0.005	mg/kg
	Dibromochloromethane	0.5	µg/L	0.003	mg/kg
	Dibromomethane	2.4	µg/L	0.01	mg/kg
	Dichlorodifluoromethane	1.0	µg/L	0.005	mg/kg
	Ethylbenzene	0.6	µg/L	0.003	mg/kg
	Hexachlorobutadiene	1.1	µg/L	0.005	mg/kg
	Isopropylbenzene	0.5	µg/L	0.008	mg/kg
	m-Xylene	0.5	µg/L	0.003	mg/kg
	Methylene chloride	0.3	µg/L	0.002	mg/kg
	n-Butylbenzene	1.1	µg/L	0.005	mg/kg
	n-Propylbenzene	0.4	µg/L	0.002	mg/kg
	Naphthalene	0.4	µg/L	0.002	mg/kg
	o-Xylene	1.1	µg/L	0.005	mg/kg
	p-Isopropyltoluene	1.2	µg/L	0.006	mg/kg
	p-Xylene	1.3	µg/L	0.007	mg/kg
	Sec-Butylbenzene	1.3	µg/L	0.007	mg/kg
	Styrene	0.4	µg/L	0.002	mg/kg
	TCE	1.0	µg/L	0.01	mg/kg
	Tert-Butylbenzene	1.4	µg/L	0.007	mg/kg
	Tetrachloroethene	1.4	µg/L	0.007	mg/kg
	Toluene	1.1	µg/L	0.005	mg/kg
	Trans-1,2-DCE	0.6	µg/L	0.003	mg/kg
	Trans-1,3-Dichloropropene	1.0	µg/L	0.005	mg/kg
	Trichlorofluoromethane	0.8	µg/L	0.004	mg/kg
	Vinyl chloride	1.1	µg/L	0.009	mg/kg

Table 7.2.14-2. QC Acceptance Criteria for Method SW8260A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8260A	1,1,1,2-Tetrachloroethane	72-125	≤ 20	62-108	≤ 30
	1,1,1-TCA	75-125	≤ 20	65-135	≤ 30
	1,1,2,2-Tetrachloroethane	74-125	≤ 20	64-135	≤ 30
	1,1,2-TCA	75-127	≤ 20	65-135	≤ 30
	1,1-DCA	72-125	≤ 20	62-135	≤ 30
	1,1-DCE	75-125	≤ 20	65-135	≤ 30
	1,1-Dichloropropene	75-125	≤ 20	65-135	≤ 30
	1,2,3-Trichlorobenzene	75-137	≤ 20	65-147	≤ 30
	1,2,3-Trichloropropane	75-125	≤ 20	65-135	≤ 30
	1,2,4-Trichlorobenzene	75-135	≤ 20	65-145	≤ 30
	1,2,4-Trimethyl Benzene	75-125	≤ 20	65-135	≤ 30
	1,2-DCA	68-127	≤ 20	58-137	≤ 30
	1,2-DCB	75-125	≤ 20	65-135	≤ 30
	1,2-Dibromo-3-chloropropane	59-125	≤ 20	49-135	≤ 30
	1,2-Dichloropropane	70-125	≤ 20	60-135	≤ 30
	1,2-EDB	75-125	≤ 20	65-135	≤ 30
	1,3,5-Trimethylbenzene	72-112	≤ 20	62-135	≤ 30
	1,3-DCB	75-125	≤ 20	65-135	≤ 30
	1,3-Dichloropropane	75-125	≤ 20	65-135	≤ 30
	1,4-DCB	75-125	≤ 20	65-135	≤ 30
	1-Chlorohexane	75-125	≤ 20	65-135	≤ 30
	2,2-Dichloropropane	75-125	≤ 20	65-135	≤ 30
	2-Chlorotoluene	73-125	≤ 20	63-135	≤ 30
	4-Chlorotoluene	74-125	≤ 20	64-135	≤ 30
	Benzene	75-125	≤ 20	65-135	≤ 30
	Bromobenzene	75-125	≤ 20	65-135	≤ 30
	Bromochloromethane	73-125	≤ 20	63-135	≤ 30
	Bromodichloromethane	75-125	≤ 20	65-135	≤ 30
	Bromoform	75-125	≤ 20	65-135	≤ 30
	Bromomethane	72-125	≤ 20	62-135	≤ 30
	Carbon Tetrachloride	62-125	≤ 20	52-135	≤ 30
	Chlorobenzene	75-125	≤ 20	65-135	≤ 30
	Chloroethane	65-125	≤ 20	55-135	≤ 30
	Chloroform	74-125	≤ 20	64-135	≤ 30
	Chloromethane	75-125	≤ 20	65-135	≤ 30
	Cis-1,2-DCE	75-125	≤ 20	65-135	≤ 30
	Cis-1,3-Dichloropropene	74-125	≤ 20	64-135	≤ 30
	Dibromochloromethane	73-125	≤ 20	63-135	≤ 30
	Dibromomethane	69-127	≤ 20	59-137	≤ 30

Table 7.2.14-2. QC Acceptance Criteria for Method SW8260A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8260A (Concluded)	Dichlorodifluoromethane	75-125	≤ 20	65-135	≤ 30
	Dichloropropene	75-125	≤ 20	65-135	≤ 30
	Ethylbenzene	75-125	≤ 20	65-135	≤ 30
	Hexachlorobutadiene	75-125	≤ 20	65-135	≤ 30
	Isopropylbenzene	75-125	≤ 20	65-135	≤ 30
	m-Xylene	75-125	≤ 20	65-135	≤ 30
	Methylene chloride	75-125	≤ 20	65-135	≤ 30
	n-Butylbenzene	75-125	≤ 20	65-135	≤ 30
	n-Propylbenzene	75-125	≤ 20	65-135	≤ 30
	Naphthalene	75-125	≤ 20	65-135	≤ 30
	o-Xylene	75-125	≤ 20	65-135	≤ 30
	p-Isopropyltoluene	75-125	≤ 20	65-135	≤ 30
	p-Xylene	75-125	≤ 20	65-135	≤ 30
	Sec-Butylbenzene	75-125	≤ 20	65-135	≤ 30
	Styrene	75-125	≤ 20	65-135	≤ 30
	TCE	71-125	≤ 20	61-135	≤ 30
	Tetrachloroethene	71-125	≤ 20	61-135	≤ 30
	Toluene	74-125	≤ 20	64-135	≤ 30
	Trans-1,2-DCE	75-125	≤ 20	65-135	≤ 30
	Trans-1,3-Dichloropropene	66-125	≤ 20	56-135	≤ 30
	Trichlorofluoromethane	67-125	≤ 20	57-135	≤ 30
	Vinyl Chloride	46-134	≤ 20	36-144	≤ 30
	Surrogates:				
	Dibromofluoromethane	75-125		65-135	
	Toluene-D8	75-125		65-135	
	4-Bromofluorobenzene	75-125		65-135	
	1,2-DCA-D4	62-139		52-149	

Table 7.2.14-3. Summary of Calibration and QC Procedures for Method SW8260A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8260A	Volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF $\geq 0.30^C$; and %RSD for all calibration analytes $\leq 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average RF $\geq 0.30^C$; and CCCs $< 20\%$ drift, and all calibration analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.14-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.14)	Retune instrument and verify	Apply R to all results for all samples associated with the tune
SW8260A	Volatile Organics	ISs	Immediately after or during data acquisition of calibration check standard	Retention time ± 30 seconds; EICP area within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometry or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply R to all results for specific analytes for all samples associated with the IS

Table 7.2.14-3. Summary of Calibration and QC Procedures for Method SW8260A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8260A		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.14-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch: if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
	Volatile Organics	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.14-2	Correct problem then reextract and analyze sample	For the samples: if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.14-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3) MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.14-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed

Table 7.2.14-3. Summary of Calibration and QC Procedures for Method SW8260A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

c. Except > 0.10 for bromoform, and > 0.01 for chloromethane and 1,1-dichloroethane

7.2.15 Method SW8270B-Semivolatile Organics

Semivolatile organics (also known as base/neutral and acid extractables) in water and soil samples are analyzed using method SW8270B. This technique determines quantitatively the concentration of a number of SVOCs. Aqueous samples are prepared using method SW3510B, solid samples are prepared by method SW3550A. Samples are extracted and both base/neutral and acid extracts are then concentrated through evaporation. Compounds of interest are separated and quantified using a capillary column GC/mass spectrometer. The PQLs are listed in Table 7.2.15-1.

The mass spectrometer is tuned every 12 hours to give an acceptable spectrum for decafluorotriphenylphosphine (DFTPP). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- 51-30 percent to 60 percent of mass 198
- 68-less than 2 percent of mass 69
- 70-less than 2 percent of mass 69
- 127-40 percent to 60 percent of mass 198
- 197-less than 1 percent of mass 198
- 198-base peak, 100 percent relative abundance
- 199-5 percent to 9 percent of mass 198
- 275-10 percent to 30 percent of mass 198
- 365-greater than 1 percent of mass 198
- 441-present, but less than mass 443
- 442-greater than 40 percent of mass 198
- 443-17 percent to 23 percent of mass 442

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS that is added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.15-2 and 7.2.15-3.

Table 7.2.15-1. PQLs for Method SW8270B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Semivolatile organics	1,2,4-Trichlorobenzene	10.0	µg/L	0.7	mg/kg
Base/Neutral Extractables	1,2-DCB	10.0	µg/L	0.7	mg/kg
SW3510B/SW8270B (W)	1,3-DCB	10.0	µg/L	0.7	mg/kg
SW3550A/SW8270B (S)	1,4-DCB	10.0	µg/L	0.7	mg/kg
	2,4-DNT	10.0	µg/L	0.7	mg/kg
	2,6-DNT	10.0	µg/L	0.7	mg/kg
	2-Chloronaphthalene	10.0	µg/L	0.7	mg/kg
	2-Methylnaphthalene	10.0	µg/L	0.7	mg/kg
	2-Nitroaniline	50.0	µg/L	3.3	mg/kg
	3-Nitroaniline	50.0	µg/L	3.3	mg/kg
	3,3'-Dichlorobenzidine	20.0	µg/L	1.3	mg/kg
	4-Bromophenyl phenyl ether	10.0	µg/L	0.7	mg/kg
	4-Chloroaniline	20.0	µg/L	1.3	mg/kg
	4-Chlorophenyl phenyl ether	10.0	µg/L	0.7	mg/kg
	4-Nitroaniline	50.0	µg/L	3.3	mg/kg
	Acenaphthylene	10.0	µg/L	0.7	mg/kg
	Acenaphthene	10.0	µg/L	0.7	mg/kg
	Anthracene	10.0	µg/L	0.7	mg/kg
	Benz (a) anthracene	10.0	µg/L	0.7	mg/kg
	Benzo (a) pyrene	10.0	µg/L	0.7	mg/kg
	Benzo (b) fluoranthene	10.0	µg/L	0.7	mg/kg
	Benzo (g,h,i) perylene	10.0	µg/L	0.7	mg/kg
	Benzyl alcohol	20.0	µg/L	1.3	mg/kg
	Bis (2-chloroethoxy) methane	10.0	µg/L	0.7	mg/kg
	Bis (2-chlorethyl) ether	10.0	µg/L	0.7	mg/kg
	Bis (2-chloroisopropyl) ether	10.0	µg/L	0.7	mg/kg
	Bis (2-ethylhexyl) phthalate	10.0	µg/L	0.7	mg/kg
	Butyl benzylphthalate	10.0	µg/L	0.7	mg/kg
	Chrysene	10.0	µg/L	0.7	mg/kg
	Di-n-butylphthalate	10.0	µg/L	0.7	mg/kg
	Di-n-octylphthalate	10.0	µg/L	0.7	mg/kg
	Dibenz (a,h) anthracene	10.0	µg/L	0.7	mg/kg
	Dibenzofuran	10.0	µg/L	0.7	mg/kg
	Diethyl phthalate	10.0	µg/L	0.7	mg/kg
	Dimethyl phthalate	10.0	µg/L	0.7	mg/kg

Table 7.2.15-1. PQLs for Method SW8270B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Semivolatile organics	Fluoranthene	10.0	µg/L	0.7	mg/kg
Base/Neutral Extractables	Fluorene	10.0	µg/L	0.7	mg/kg
SW3510B/SW8270B (W)	Hexachlorobenzene	10.0	µg/L	0.7	mg/kg
SW3550A/SW8270B (S)	Hexachlorobutadiene	10.0	µg/L	0.7	mg/kg
(concluded)	Hexachlorocyclopentadiene	10.0	µg/L	0.7	mg/kg
	Hexachloroethane	10.0	µg/L	0.7	mg/kg
	Indeno (1,2,3-cd) pyrene	10.0	µg/L	0.7	mg/kg
	Isophorone	10.0	µg/L	0.7	mg/kg
	n-Nitrosodiphenylamine	10.0	µg/L	0.7	mg/kg
	n-Nitrosodi-n-propylamine	10.0	µg/L	0.7	mg/kg
	Naphthalene	10.0	µg/L	0.7	mg/kg
	Nitrobenzene	10.0	µg/L	0.7	mg/kg
	Phenanthrene	10.0	µg/L	0.7	mg/kg
	Pyrene	10.0	µg/L	0.7	mg/kg
Semivolatile organics	2,4,5-Trichlorophenol	50.0	µg/L	3.3	mg/kg
Acid Extractables	2,4,6-Trichlorophenol	10.0	µg/L	0.3	mg/kg
SW3510B/SW8270B (W)	2,4-Dichlorophenol	10.0	µg/L	0.3	mg/kg
SW3550A/SW8270B (S)	2,4-Dimethylphenol	10.0	µg/L	0.3	mg/kg
	2,4-Dinitrophenol	50.0	µg/L	3.3	mg/kg
	2-Chlorophenol	10.0	µg/L	0.3	mg/kg
	2-Methylphenol	10.0	µg/L	0.3	mg/kg
	2-Nitrophenol	10.0	µg/L	0.3	mg/kg
	4,6-Dinitro-2-methylphenol	50.0	µg/L	3.3	mg/kg
	4-Chloro-3-methylphenol	20.0	µg/L	1.3	mg/kg
	4-Methylphenol	10.0	µg/L	0.3	mg/kg
	4-Nitrophenol	50.0	µg/L	1.6	mg/kg
	Benzoic acid	50.0	µg/L	1.6	mg/kg
	Pentachlorophenol	50.0	µg/L	3.3	mg/kg
	Phenol	10.0	µg/L	0.3	mg/kg

Table 7.2.15-2. QC Acceptance Criteria for Method SW8270B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8270B	1,2,4-Trichlorobenzene	44-142	≤ 20	34-152	≤ 30
	1,2-DCB	42-155	≤ 20	32-135	≤ 30
	1,3-DCB	36-125	≤ 20	26-135	≤ 30
	1,4-DCB	30-125	≤ 20	25-135	≤ 30
	2,4-DNT	39-139	≤ 20	29-149	≤ 30
	2,6-DNT	51-125	≤ 20	41-135	≤ 30
	2-Chloronaphthalene	60-125	≤ 20	50-135	≤ 30
	2-Methylnaphthalene	41-125	≤ 20	31-135	≤ 30
	2-Nitroaniline	50-125	≤ 20	40-135	≤ 30
	3,3'-Dichlorobenzidine	29-175	≤ 20	25-175	≤ 30
	3-Nitroaniline	51-125	≤ 20	41-135	≤ 30
	4-Bromophenyl phenyl ether	53-127	≤ 20	43-137	≤ 30
	4-Chloroaniline	45-136	≤ 20	35-146	≤ 30
	4-Chlorophenyl phenyl ether	51-132	≤ 20	41-142	≤ 30
	4-Nitroaniline	40-143	≤ 20	30-153	≤ 30
	Acenaphthylene	47-125	≤ 20	37-135	≤ 30
	Acenaphthene	49-125	≤ 20	39-135	≤ 30
	Anthracene	45-165	≤ 20	35-175	≤ 30
	Benz (a) anthracene	51-133	≤ 20	41-143	≤ 30
	Benzo (a) pyrene	41-125	≤ 20	31-135	≤ 30
	Benzo (b) fluoranthene	37-125	≤ 20	27-135	≤ 30
	Benzo (g,h,i) perylene	34-149	≤ 20	25-159	≤ 30
	Benzyl alcohol	35-125	≤ 20	25-135	≤ 30
	Bis (2-chloroethoxy) methane	49-125	≤ 20	39-135	≤ 30
	Bis (2-chloroethyl) ether	44-125	≤ 20	34-135	≤ 30
	Bis (2-chloroisopropyl) ether	36-166	≤ 20	26-175	≤ 30
	Bis (2-ethylhexyl) phthalate	33-129	≤ 20	25-139	≤ 30
	Butyl Benzyl Phthalate	26-125	≤ 20	25-135	≤ 30
	Chrysene	55-133	≤ 20	45-143	≤ 30
	Di-n-Butyl Phthalate	34-126	≤ 20	25-136	≤ 30

Table 7.2.15-2. QC Acceptance Criteria for Method SW8270B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
	Di-n-Octyl Phthalate	38-127	≤ 20	28-137	≤ 30
	Dibenz (a,h) Anthracene	50-125	≤ 20	40-135	≤ 30
	Dibenzofuran	52-125	≤ 20	42-135	≤ 30
	Diethyl Phthalate	37-125	≤ 20	27-135	≤ 30
	Dimethyl Phthalate	25-175	≤ 20	25-175	≤ 30
	Fluoranthene	47-125	≤ 20	37-135	≤ 30
	Fluorene	48-139	≤ 20	38-149	≤ 30
	Hexachlorobenzene	46-133	≤ 20	36-143	≤ 30
	Hexachlorobutadiene	25-125	≤ 20	25-135	≤ 30
	Hexachlorocyclopentadiene	41-125	≤ 20	31-135	≤ 30
	Hexachloroethane	25-153	≤ 20	25-163	≤ 30
	Indeno (1,2,3-c,d) Pyrene	27-160	≤ 20	25-170	≤ 30
	Isophorone	26-175	≤ 20	25-175	≤ 30
	n-Nitrosodi-n-propylamine	37-125	≤ 20	27-135	≤ 30
	n-Nitrosodiphenylamine	27-125	≤ 20	25-135	≤ 30
	Naphthalene	50-125	≤ 20	40-135	≤ 30
	Nitrobenzene	46-133	≤ 20	36-143	≤ 30
	Phenanthrene	54-125	≤ 20	44-135	≤ 30
	Pyrene	47-136	≤ 20	37-146	≤ 30
	2,4,5-Trichlorophenol	25-175	≤ 20	25-175	≤ 30
	2,4,6-Trichlorophenol	39-128	≤ 20	29-138	≤ 30
	2,4-Dichlorophenol	46-125	≤ 20	36-135	≤ 30
	2,4-Dimethylphenol	45-139	≤ 20	35-149	≤ 30
	2,4-Dinitrophenol	30-151	≤ 20	25-161	≤ 30
	2-Chlorophenol	41-125	≤ 20	31-135	≤ 30
	2-Methylphenol	25-125	≤ 20	25-135	≤ 30
	2-Nitrophenol	44-125	≤ 20	34-135	≤ 30
	4,6-Dinitro-2-Methyl Phenol	26-134	≤ 20	25-144	≤ 30
	4-Chloro-3-Methyl Phenol	44-125	≤ 20	34-135	≤ 30
	4-Methylphenol	33-125	≤ 20	25-135	≤ 30
	4-Nitrophenol	25-131	≤ 20	25-141	≤ 30

Table 7.2.15-2. QC Acceptance Criteria for Method SW8270B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8270B (Concluded)	Benzoic Acid	25-162	≤ 20	25-172	≤ 30
	Pentachlorophenol	28-136	≤ 20	38-146	≤ 30
	Phenol	25-125	≤ 20	25-135	≤ 30
	Surrogates:				
	2,4,6-Tribromophenol	25-134		25-144	
	2-Fluorobiphenyl	43-125		34-135	
	2-Fluorophenol	25-125		25-135	
	Nitrobenzene-D5	32-125		25-135	
	Phenol-D5	25-125		25-135	
	Terphenyl-D14	42-126		32-136	

Table 7.2.15-3. Summary of Calibration and QC Procedures for Method SW8270B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8270B	Semi-volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF ≥ 0.05 ; and %RSD for all calibration analytes $\leq 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average RF ≥ 0.05 ; and CCCs $< 20\%$ drift; and all calibration analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.15-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.15)	Retune instrument and verify	Apply R to all results for all samples associated with the tune
SW8270B	Semi-volatile Organics	ISs	Immediately after or during data acquisition of calibration check standard	Retention time ± 30 seconds; EICP area within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometry or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply R to all results for specific analytes for all samples associated with the IS

Table 7.2.15-3. Summary of Calibration and QC Procedures for Method SW8270B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8270B		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.15-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
	Semi-volatile Organics	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.15-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.15-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3) MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.15-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed

Table 7.2.15-3. Summary of Calibration and QC Procedures for Method SW8270B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.16 Method SW8280-Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans

Method SW8280 is used to analyze for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in water, soil, and waste. This GC/MS method uses matrix-specific extraction, analyte-specific cleanup, and high-resolution capillary column GC/low resolution mass spectrometry techniques to separate and identify the analytes of interest. The sensitivity of the method is dependent on the level of matrix interference. Selected cleanup methods may be used to reduce or eliminate interferences. Target analytes include all congener classes, tetra- through octa-dioxins and furans. Achieved detection limits vary according to matrix and analyte. Because of the extreme toxicity of these compounds, the analyst must take appropriate precautions during preparation and analysis to prevent accidental exposure. PQLs are presented in Table 7.2.16-1.

A tetrachlorinated dibenzo-p-dioxin (TCDD) chromatographic test mixture is analyzed daily to verify that there is at least 25 percent valley resolution between 2,3,7,8 TCDD and 1,2,3,4 TCDD. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.16-2 and 7.2.16-3.

Table 7.2.16-1. PQLs for Method SW8280

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Dioxins and Furans SW8280 (W, S)	2,3,7,8-TCDD	4.4	ng/L	1.7	µg/kg
	2,3,7,8-TCDF	1.0	ng/L	1.1	µg/kg

Table 7.2.16-2. QC Acceptance Criteria for Method SW8280

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8280	2,3,7,8-TCDD	50-140	≤ 30	56-140	≤ 50
	2,3,7,8-TCDF	50-140	≤ 30	50-140	≤ 50
	Surrogates:				
	C13-2,3,7,8-TCDF	40-125		30-135	
	C13-2,3,7,8-TCDD	40-125		30-135	

Table 7.2.16-3. Summary of Calibration and QC Procedures for Method SW8280

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8280	Dioxins/ Furans	Check mass spectral ion intensity	Prior to each initial calibration	See footnote c	Retune instrument; verify	Apply R to all results associated with the tune
		Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD \leq 15% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to the result for the specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	\pm 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to the result for the specific analyte(s) in the sample
		Column performance check	Prior to sample analysis, at the beginning of every 12-hour period, and at the end of the final run period	A \leq 25% valley between 1,2,3,4-TCDD and 2,3,7,8-TCDD	Correct problem then repeat until criteria are met	Apply R to all tetra isomers if valley is $>$ 5%
		Calibration verification (500 ng/mL standard)	As part of initial calibration and at the beginning of each 12-hour period	RF within 30% (RPD) of average initial multipoint RF; isotope ratios in agreement with footnote c	Correct problem then repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification	Apply R to the result for the specific analyte(s) for all samples associated with the calibration
		Sensitivity check (200 ng/mL standard)	As part of initial calibration and at the beginning of each 12-hour period	S/N for 2,3,7,8-TCDD standard \geq 50:1	Correct problem then repeat initial calibration and reanalyze all samples analyzed since the last successful sensitivity check	Apply R to all analytes if S/N is \leq 50:1
SW8280	Dioxins/ Furans	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.16-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to the specific analyte(s) result for all samples analyzed by the analyst

Table 7.2.16-3. Summary of Calibration and QC Procedures for Method SW8280

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^a
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to the result for specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.16-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
SW8280	Dioxins/ Furans	Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.16-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects. If any surrogate recovery is < 10%, apply R to all results
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.16-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.1-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
SW8280	Dioxins/ Furans	Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
- c. The acceptance criteria for spectral ion intensities are given below:

PCDDs	Selected Ions (m/z)	Relative Intensity	PCDFs	Selected Ions (m/z)	Relative Intensity
Tetra	320/322	0.65-0.89	Tetra	304/306	0.65-0.89
Penta	358/356	0.55-0.75	Penta	342/340	0.55-0.75
Hexa	392/390	0.69-0.93	Hexa	376/374	0.69-0.93
Hepta	426/424	0.83-1.12	Hepta	410/408	0.83-1.12
Octa	458/460	0.75-1.01	Octa	442/444	0.75-1.01

7.2.17 Method SW8310—Polynuclear Aromatic Hydrocarbons

Method SW8310 is used to determine the concentration of ppb levels of selected polynuclear aromatic hydrocarbons (PAHs) in groundwater and soils by HPLC. Aqueous samples are prepared using method SW3510B, solid samples are prepared by method SW3550A. Samples are analyzed by direct injection. Detection is by ultraviolet and fluorescent detectors. PQLs are listed in Table 7.2.17-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.17-2 and 7.2.17-3.

Table 7.2.17-1. PQLs for Method SW8310

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Polynuclear Aromatic	Acenaphthene	18.0	µg/L	1.2	mg/kg
Hydrocarbons	Acenaphthylene	23.0	µg/L	1.54	mg/kg
SW3510B/SW8310 (W)	Anthracene	6.6	µg/L	0.44	mg/kg
SW3550A/SW8310 (S)	Benz (a) anthracene	0.13	µg/L	0.009	mg/kg
	Benzo (a) pyrene	0.23	µg/L	0.015	mg/kg
	Benzo (b) fluoranthene	0.18	µg/L	0.012	mg/kg
	Benzo (g,h,i) perylene	0.76	µg/L	0.05	mg/kg
	Benzo (k) fluoranthene	0.17	µg/L	0.011	mg/kg
	Chrysene	1.5	µg/L	0.1	mg/kg
	Dibenzo (a,h) anthracene	0.3	µg/L	0.02	mg/kg
	Fluoranthrene	2.1	µg/L	0.14	mg/kg
	Fluorene	2.1	µg/L	0.14	mg/kg
	Indeno (1,2,3-c,d) pyrene	0.43	µg/L	0.03	mg/kg
	Naphthalene	18.0	µg/L	1.2	mg/kg
	Phenanthrene	6.4	µg/L	0.42	mg/kg
	Pyrene	2.7	µg/L	0.18	mg/kg

Table 7.2.17-2. QC Acceptance Criteria for Method SW8310

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8310	Acenaphthalene	49-125	≤ 30	39-135	≤ 50
	Acenaphthene	43-130	≤ 30	33-140	≤ 50
	Anthracene	54-125	≤ 30	44-135	≤ 50
	Benzo (a) Anthracene	39-135	≤ 30	29-145	≤ 50
	Benzo (a) Pyrene	52-125	≤ 30	42-135	≤ 50
	Benzo (b) Fluoranthene	31-137	≤ 30	25-147	≤ 50
	Benzo (g,h,i) Perylene	53-125	≤ 30	43-135	≤ 50
	Benzo (k) Fluoranthene	60-129	≤ 30	50-139	≤ 50
	Chrysene	59-134	≤ 30	49-144	≤ 50
	Dibenzo (a,h) Anthracene	51-125	≤ 30	41-135	≤ 50
	Fluoranthene	42-125	≤ 30	32-135	≤ 50
	Fluorene	53-125	≤ 30	43-135	≤ 50
	Indeno (1,2,3-c,d) Pyrene	55-125	≤ 30	45-135	≤ 50
	Naphthalene	43-125	≤ 30	33-135	≤ 50
	Phenanthrene	52-129	≤ 30	42-139	≤ 50
	Pyrene	55-125	≤ 30	45-135	≤ 50
	Surrogates:				
	Terphenyl-D14	25-157		22-167	

Table 7.2.17-3. Summary of Calibration and QC Procedures for Method SW8310

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8310	PAHs	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.17-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8310	PAHs	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.17-3. Summary of Calibration and QC Procedures for Method SW8310

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.17-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.17-2	Correct problem then reextract and analyze sample.	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects If any surrogate recovery is < 10%, apply R to all results
SW8310	PAHs	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.17-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Confirmation ^c	100% for all positive results	Same as for initial or primary analysis	Same as for initial or primary analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.17-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
- Use a second column or different detector

7.2.18 Method SW8330—Explosive Residues

Method SW8330 provides HPLC conditions for the detection of ppb levels of certain explosive residues in a water, soil, and sediment matrix. Prior to using this method, appropriate sample preparation techniques must be used.

In the low-level, salting-out method with no evaporation, aqueous samples of low concentration are extracted by a salting-out extraction procedure. An aliquot of the extract is separated on a C-18 reverse-phase column, determined at 254 nm, and confirmed on a cyanide reverse-phase column.

In the high-level direct injection method, aqueous samples of higher concentration can be diluted, filtered, separated on a C-18 reverse-phase column, determined at 254 nm, and confirmed on a cyanide reverse-phase column.

Soil and sediment samples are extracted in an ultrasonic bath and filtered before chromatography.

PQLs are listed in Table 7.2.18-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.18-2 and 7.2.18-3.

Table 7.2.18-1. PQLs for Method SW8330

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Explosive Residues SW8330	1,3,5- TNB	7.3	µg/L	0.25	mg/kg
	1,3- DNB	4.0	µg/L	0.25	mg/kg
	2,4,6- TNT	6.9	µg/L	0.25	mg/kg
	2,4-DNT	5.7	µg/L	0.25	mg/kg
	2,6-DNT	9.4	µg/L	0.26	mg/kg
	HMX	13.0	µg/L	2.2	mg/kg
	m-Nitrotoluene	7.9	µg/L	0.25	mg/kg
	Methyl-2,4,6-trinitrophenylnitramine	44.0	µg/L	0.65	mg/kg
	Nitrobenzene	7.0	µg/L	0.26	mg/kg
	o-Nitrotoluene	12.0	µg/L	0.25	mg/kg
	p-Nitrotoluene	8.5	µg/L	0.25	mg/kg
	RDX	14.0	µg/L	1.0	mg/kg

Table 7.2.18-2. QC Acceptance Criteria for Method SW8330

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8330	1,3,5-TNB	75-142	≤ 30	65-152	≤ 50
	1,3-DNB	75-125	≤ 30	65-135	≤ 50
	2,4,6-TNT	75-128	≤ 30	65-138	≤ 50
	2,4-DNT	75-125	≤ 30	65-135	≤ 50
	2,6-DNT	75-129	≤ 30	65-139	≤ 50
	HMX	74-137	≤ 30	64-147	≤ 50
	m-Nitrotoluene	60-134	≤ 30	50-144	≤ 50
	Methyl-2,4,6-Trinitrophenylnitramine	44-142	≤ 30	34-152	≤ 50
	Nitrobenzene	29-134	≤ 30	25-144	≤ 50
	o-Nitrotoluene	75-129	≤ 30	65-139	≤ 50
	p-Nitrotoluene	42-150	≤ 30	32-160	≤ 50
	RDX	75-132	≤ 30	65-142	≤ 50
	Surrogates*				

- a. Use an analyte and its LCS limit from the method that is not expected to be present in the sample as the surrogate.

Table 7.2.18-3. Summary of Calibration and QC Procedures for Method SW8330

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8330	Explosives	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD < 20% for CFs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.18-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW8330	Explosives	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.18-3. Summary of Calibration and QC Procedures for Method SW8330

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.18-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.18-2	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for any surrogate, apply J to all positive results if the %R < LCL for any surrogate, apply J to all positive results, apply R to all non-detects if any surrogate recovery is < 10%, apply R to all results
SW8330	Explosives	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.18-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Confirmation ^c	100% for all positive results	Same as for initial or primary analysis	Same as for initial or primary analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.18-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
- Use a second column or different detector

7.2.19 Method SW6010A-Trace Elements (Metals) by Inductively Coupled Plasma Emission Spectroscopy for Water and Soil

Samples are analyzed for trace elements or metals using method SW6010A for water and soils. Analysis for most metals requires digestion of the sample. This digestion is performed by method SW3005A for water or method SW3050A for soil. Following digestion, the trace elements are determined simultaneously or sequentially using (Inductively Coupled Plasma Emission Spectroscopy) ICPEs. The elements and corresponding PQLs for this method are listed in Table 7.2.19-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.19-2 and 7.2.19-3.

Table 7.2.19-1. PQLs for Method SW6010A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
ICP Screen for Metals SW3005A/SW6010A (W) SW3050A/SW6010A (S)	Aluminum	0.5	mg/L	50.0	mg/kg
	Antimony	0.4	mg/L	40.0	mg/kg
	Arsenic	0.6	mg/L	60.0	mg/kg
	Barium	0.02	mg/L	2.0	mg/kg
	Beryllium	0.003	mg/L	0.3	mg/kg
	Cadmium	0.04	mg/L	4.0	mg/kg
	Calcium	0.1	mg/L	10.0	mg/kg
	Chromium	0.07	mg/L	7.0	mg/kg
	Cobalt	0.07	mg/L	7.0	mg/kg
	Copper	0.06	mg/L	6.0	mg/kg
	Iron	0.07	mg/L	7.0	mg/kg
	Lead	0.5	mg/L	50.0	mg/kg
	Magnesium	0.3	mg/L	30.0	mg/kg
	Manganese	0.02	mg/L	2.0	mg/kg
	Molybdenum	0.08	mg/L	8.0	mg/kg
	Nickel	0.15	mg/L	15.0	mg/kg
	Potassium	5.0	mg/L	500.0	mg/kg
	Selenium	0.8	mg/L	80.0	mg/kg
	Silver	0.07	mg/L	7.0	mg/kg
	Sodium	0.3	mg/L	30.0	mg/kg
	Thallium	0.4	mg/L	40.0	mg/kg
	Vanadium	0.08	mg/L	8.0	mg/kg
	Zinc	0.02	mg/L	2.0	mg/kg

Table 7.2.19-2. QC Acceptance Criteria for Method SW6010A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW6010A	Aluminum	80-120	≤ 15	80-120	≤ 25
	Antimony	80-120	≤ 15	80-120	≤ 25
	Arsenic	80-120	≤ 15	80-120	≤ 25
	Barium	80-120	≤ 15	80-120	≤ 25
	Beryllium	80-120	≤ 15	80-120	≤ 25
	Cadmium	80-120	≤ 15	80-120	≤ 25
	Calcium	80-120	≤ 15	80-120	≤ 25
	Chromium	80-120	≤ 15	80-120	≤ 25
	Cobalt	80-120	≤ 15	80-120	≤ 25
	Copper	80-120	≤ 15	80-120	≤ 25
	Iron	80-120	≤ 15	80-120	≤ 25
	Lead	80-120	≤ 15	80-120	≤ 25
	Magnesium	80-120	≤ 15	80-120	≤ 25
	Manganese	80-120	≤ 15	80-120	≤ 25
	Molybdenum	80-120	≤ 15	80-120	≤ 25
	Nickel	80-120	≤ 15	80-120	≤ 25
	Potassium	80-120	≤ 15	80-120	≤ 25
	Selenium	80-120	≤ 15	80-120	≤ 25
	Silver	80-120	≤ 15	80-120	≤ 25
	Sodium	80-120	≤ 15	80-120	≤ 25
	Thallium	80-120	≤ 15	80-120	≤ 25
	Vanadium	80-120	≤ 15	80-120	≤ 25
	Zinc	80-120	≤ 15	80-120	≤ 25

Table 7.2.19-3. Summary of Calibration and QC Procedures for Method SW6010A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW6010A	ICP Metals	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Highest calibration standard	Before beginning a sample run	All analytes within $\pm 5\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration blank	After every 10 samples and at end of the analysis sequence	No analytes detected > PQL	Correct problem then analyze calibration blank and previous 10 samples	Apply B to all results for specific analyte(s) in all samples associated with the blank
		Continuing calibration verification (Instrument Check Standard)	After every 10 samples and at the end of the analysis sequence	All analyte(s) within $\pm 10\%$ of expected value	Repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.19-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW6010A	ICP Metals	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		Interference check solution (ICS)	At the beginning and end of an analytical run or twice during an 8 hour period, whichever is more frequent	Within $\pm 20\%$ of expected value	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples	Apply R to all results for specific analyte(s) in all samples associated with the ICS

Table 7.2.19-3. Summary of Calibration and QC Procedures for Method SW6010A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW6010A	ICP Metals	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.19-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Dilution test	Each new sample matrix	1:4 dilution must agree within $\pm 10\%$ of the original determination	Perform post digestion spike addition	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Post digestion spike addition	When dilution test fails	Recovery within 75-125% of expected results	Correct problem then reanalyze post digestion spike addition	Apply J to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post digestion spike addition
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.19-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.19-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.20 Method SW6020-Trace Elements (Metals) by Inductively Coupled Plasma Mass Spectroscopy for Water and Soil

Samples are analyzed for trace elements or metals using method SW6020 for water and soils. Analysis for total (i.e., acid leachable) metals requires digestion of the sample by method SW3005A for water or method SW3050A for soil. Following digestion, the trace elements are determined simultaneously or sequentially using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). The elements and PQLs for this method are listed in Table 7.2.20-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.20-2 and 7.2.20-3.

Table 7.2.20-1. PQLs for Method SW6020

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
ICP Screen for Metals SW3005A/SW6020 (W) SW3050A/SW6020 (S)	Aluminum	0.0004	mg/L	50.0	mg/kg
	Antimony	0.4	mg/L	40.0	mg/kg
	Arsenic	0.6	mg/L	60.0	mg/kg
	Barium	0.02	mg/L	2.0	mg/kg
	Beryllium	0.003	mg/L	0.3	mg/kg
	Cadmium	0.04	mg/L	4.0	mg/kg
	Chromium	0.07	mg/L	7.0	mg/kg
	Cobalt	0.07	mg/L	7.0	mg/kg
	Copper	0.06	mg/L	6.0	mg/kg
	Lead	0.5	mg/L	50.0	mg/kg
	Magnesium	0.3	mg/L	30.0	mg/kg
	Manganese	0.02	mg/L	2.0	mg/kg
	Nickel	0.15	mg/L	15.0	mg/kg
	Silver	0.07	mg/L	7.0	mg/kg
	Thallium	0.4	mg/L	40.0	mg/kg
	Zinc	0.02	mg/L	2.0	mg/kg

Table 7.2.20-2. QC Acceptance Criteria for Method SW6020

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW6020	Aluminum	80-120	≤ 15	80-120	≤ 25
	Antimony	80-120	≤ 15	80-120	≤ 25
	Arsenic	80-120	≤ 15	80-120	≤ 25
	Barium	80-120	≤ 15	80-120	≤ 25
	Beryllium	80-120	≤ 15	80-120	≤ 25
	Cadmium	80-120	≤ 15	80-120	≤ 25
	Chromium	80-120	≤ 15	80-120	≤ 25
	Cobalt	80-120	≤ 15	80-120	≤ 25
	Copper	80-120	≤ 15	80-120	≤ 25
	Lead	80-120	≤ 15	80-120	≤ 25
	Manganese	80-120	≤ 15	80-120	≤ 25
	Nickel	80-120	≤ 15	80-120	≤ 25
	Silver	80-120	≤ 15	80-120	≤ 25
	Thallium	80-120	≤ 15	80-120	≤ 25
	Zinc	80-120	≤ 15	80-120	≤ 25

Table 7.2.20-3. Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW6020	ICP/MS Metals	MS tuning sample	Prior to initial calibration and calibration verification	RSD $\leq 5\%$ for all analytes	Retune instrument then reanalyze tuning solution	Apply R to all results for all analytes for all samples associated with the MS tuning
		Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration blank	Before beginning a sample run, after every 10 samples and at end of the analysis sequence	No analytes detected > PQL	Correct problem then analyze calibration blank and previous 10 samples	Apply B to all results for specific analyte(s) in all samples associated with the blank
		Continuing calibration verification (Instrument Check Standard)	Before beginning a sample run, after every 10 samples and at the end of the analysis sequence	All analyte(s) within $\pm 10\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.20-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
SW6020	ICP/MS Metals	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch

Table 7.2.20-3. Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Interference check solution (ICS)	At the beginning and end of an analytical run or twice during an 12 hour period, whichever is more frequent	Within $\pm 20\%$ of expected value	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all affected samples	Apply R to all results for specific analyte(s) in all samples associated with the ICS
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.20-2	Correct problem reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		Dilution test	Each new sample matrix	1:4 dilution must agree within $\pm 10\%$ of the original determination	Perform post digestion spike addition	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Post digestion spike addition	When dilution test fails	Recovery within 75-125% of expected results	Dilute the sample; reanalyze post digestion spike addition	Apply J to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post digestion spike addition
SW6020	ICP/MS Metals	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.20-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Internal Standards (ISs)	Every sample	IS intensity within 30-120% of intensity of the IS in the initial calibration	Perform corrective action as described in method SW6020, section 8.3	Apply R to all results for specific analyte(s) in all samples associated with the IS.

Table 7.2.20-3. Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		MDL study	Every three months	Detection limits established shall be < the PQLs in Table 7.2.20-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.21 Method SW7041—Graphite Furnace Atomic Absorption (Antimony)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3005A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the antimony. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.21-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.21-2 and 7.2.21-3.

Table 7.2.21-1. PQLs for Method SW7041

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3050A/SW7041 (W) SW3050A/SW7041 (S)	Antimony	0.005	mg/L	0.5	mg/kg

Table 7.2.21-2. QC Acceptance Criteria for Method SW7041

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7041	Antimony	75-125	≤ 15	75-125	≤ 15

Table 7.2.21-3. Summary of Calibration and QC Procedures for Method SW7041

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^a
SW7041	Antimony	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.21-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7041	Antimony	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.21-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.21-3. Summary of Calibration and QC Procedures for Method SW7041

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7041		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
	Antimony	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.21-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.21-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.22 Method SW7060A–Graphite Furnace Atomic Absorption (Arsenic)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using procedures described in the method or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the arsenic. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.22-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.22-2 and 7.2.22-3.

Table 7.2.22-1. PQLs for Method SW7060A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7060A (W) SW3050A/SW7060A (S)	Arsenic	0.005	mg/L	0.5	mg/kg

Table 7.2.22-2. QC Acceptance Criteria for Method SW7060A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7060A	Arsenic	74-120	≤ 15	74-120	≤ 15

Table 7.2.22-3. Summary of Calibration and QC Procedures for Method SW7060A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7060A	Arsenic	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.22-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7060A	Arsenic	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.22-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch, if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.22-3. Summary of Calibration and QC Procedures for Method SW7060A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7060A		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
	Arsenic	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.22-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD $> UCL$ or (2)%R for MS or MSD $< LCL$ or (3)MS/MSD RPD $> CL$
		MDL study	Once per year	Detection limits established shall be $<$ the PQLs in Table 7.2.22-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.23 Method SW7131A–Graphite Furnace Atomic Absorption (Cadmium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Cadmium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analytes are listed in Table 7.2.23-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.23-2 and 7.2.23-3.

Table 7.2.23-1. PQLs for Method SW7131A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7131A (W) SW3050A/SW7131A (S)	Cadmium	0.001	mg/L	0.1	mg/kg

Table 7.2.23-2. QC Acceptance Criteria for Method SW7131A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7131A	Cadmium	80-122	≤ 15	80-122	≤ 15

Table 7.2.23-3. Summary of Calibration and QC Procedures for Method SW7131A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7131A	Cadmium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.23-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7131A	Cadmium	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.23-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.23-3. Summary of Calibration and QC Procedures for Method SW7131A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
SW7131A	Cadmium	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.23-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD $> \text{UCL}$ or (2)%R for MS or MSD $< \text{LCL}$ or (3)MS/MSD RPD $> \text{CL}$
		MDL study	Once per year	Detection limits established shall be $<$ the PQLs in Table 7.2.23-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.24 Method SW7191–Graphite Furnace Atomic Absorption (Chromium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Chromium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analytes are listed in Table 7.2.24-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.24-2 and 7.2.24-3.

Table 7.2.24-1. PQLs for Method SW7191

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7191 (W) SW3050A/SW7191 (S)	Chromium	0.005	mg/L	0.5	mg/kg

Table 7.2.24-2. QC Acceptance Criteria for Method SW7191

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7191	Chromium	80-121	≤ 15	80-121	≤ 15

Table 7.2.24-3. Summary of Calibration and QC Procedures for Method SW7191

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7191	Chromium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.24-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7191	Chromium	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.24-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.24-3. Summary of Calibration and QC Procedures for Method SW7191

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7191	Chromium	New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.24-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
SW7191	Chromium	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.24-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.25 Method SW7196-Hexavalent Chromium (Colorimetric)

Dissolved hexavalent chromium, in the absence of interfering amounts of substances such as molybdenum, vanadium, and mercury, may be determined colorimetrically. PQLs for this method are listed in Table 7.2.25-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.25-2 and 7.2.25-3.

Table 7.2.25-1. PQLs for Method SW7196

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7196	Hexavalent Chromium	0.5	mg/L	1.0	mg/kg

Table 7.2.25-2. QC Acceptance Criteria for Method SW7196

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7196	Hexavalent Chromium	86-117	≤ 15	86-117	≤ 25

Table 7.2.25-3. Summary of Calibration and QC Procedures for Method SW7196A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7196A	Hexavalent Chromium	Multipoint calibration curve (minimum three standards and a blank)	Initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to the specific analyte result for all samples associated with the calibration
		Second-source calibration verification	After each new stock standard preparation	Analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to the specific analyte result for all samples associated with the calibration
		Continuing calibration verification	After every 15 samples and at the end of the analysis sequence	Chromium within $\pm 20\%$ of expected value	Correct problem then repeat initial calibration and reanalyze all samples since last successful calibration	Apply R to the specific analyte result in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.25-2	Recalculate results; locate and fix problem with system and then rerun demonstration	Apply R to the specific analyte result for all samples analyzed by the analyst
		Verification check to ensure lack of reducing condition and/or interference	Once for every sample matrix analyzed	Spike recovery between 85-115%	If check indicates interference, dilute and reanalyze sample; persistent interference indicates the need to use and alternate method	Apply R to the specific analyte result for all samples analyzed since the last acceptable verification check
		MDL study	Once per year	Detection limits established shall be $<$ the PQLs in Table 7.2.1-1	none	Apply R to all specific analyte results for all samples analyzed

Table 7.2.25-3. Summary of Calibration and QC Procedures for Method SW7196A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7196A	Chromium	Method blank	One per analytical batch	No analyte detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to the specific analyte result for all samples in the associated analytical batch
		LCS	One LCS per analytical batch	QC acceptance criteria, Table 7.2.25-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.25-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.26 Method SW7421–Graphite Furnace Atomic Absorption (Lead)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Lead. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.26-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.26-2 and 7.2.26-3.

Table 7.2.26-1. PQLs for Method SW7421

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7421 (W) SW3050A/SW7421 (S)	Lead	0.005	mg/L	0.5	mg/kg

Table 7.2.26-2. QC Acceptance Criteria for Method SW7421

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7421	Lead	74-124	≤ 15	74-124	≤ 25

Table 7.2.26-3. Summary of Calibration and QC Procedures for Method SW7421

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7421	Lead	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.26-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7421	Lead	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.26-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.26-3. Summary of Calibration and QC Procedures for Method SW7421

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7421	Lead	New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.26-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
SW7421	Lead	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.26-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.27 Method SW7470A/SW7471A–Mercury Manual Cold-Vapor Technique

Water and soil samples are analyzed for mercury using methods SW7470A and SW7471A, respectively. This method is a cold-vapor, flameless atomic absorption (AA) technique based on the absorption of radiation by mercury vapor. Mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an AA spectrophotometer. Mercury concentration is measured as a function of absorbance. The PQLs for these methods are listed in Table 7.2.27-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.27-2 and 7.2.27-3.

Table 7.2.27-1. PQLs for Method SW7470A/SW7471A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7470A (W) SW7471A (S)	Mercury	0.001	mg/L	0.1	mg/kg

Table 7.2.27-2. QC Acceptance Criteria for Method SW7470A/SW7471A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7470A/ SW7471A	Mercury	77-120	≤ 15	77-120	≤ 25

Table 7.2.27-3. Summary of Calibration and QC Procedures for Method SW7470A/SW7471A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7470A SW7471A	Mercury	Initial multipoint calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.27-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch

**Table 7.2.27-3. Summary of Calibration and QC Procedures for Method
SW7470A/SW7471A**

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7470A SW7471A	Mercury	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.27-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
SW7470A SW7471A	Mercury	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.27-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3) MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.27-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.28 Method SW7740-Graphite Furnace Atomic Absorption (Selenium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are prepared using procedures described in the method or SW3050A, as appropriate.. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Selenium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.28-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.28-2 and 7.2.28-3.

Table 7.2.28-1. PQLs for Method SW7740

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7740 (W) SW3050A/SW7740 (S)	Selenium	0.005	mg/L	0.5	mg/kg

Table 7.2.28-2. QC Acceptance Criteria for Method SW7740

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7740	Selenium	73-122	≤ 15	73-122	≤ 25

Table 7.2.28-3. Summary of Calibration and QC Procedures for Method SW7740

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7740	Selenium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.28-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7740	Selenium	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.28-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.28-3. Summary of Calibration and QC Procedures for Method SW7740

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
SW7740	Selenium	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.28-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD $> UCL$ or (2)%R for MS or MSD $< LCL$ or (3)MS/MSD RPD $> CL$
		MDL study	Once per year	Detection limits established shall be $<$ the PQLs in Table 7.2.28-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.29 Method SW7841–Graphite Furnace Atomic Absorption (Thallium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Thallium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.29-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.29-2 and 7.2.29-3.

Table 7.2.29-1. PQLs for Method SW7841

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7841 (W)	Thallium	0.001	mg/L	0.1	mg/kg
SW3050A/SW7841 (S)					

Table 7.2.29-2. QC Acceptance Criteria for Method SW7841

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7841	Thallium	78-123	≤ 15	78-123	≤ 25

Table 7.2.29-3. Summary of Calibration and QC Procedures for Method SW7841

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7841	Thallium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.29-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7841	Thallium	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.29-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.29-3. Summary of Calibration and QC Procedures for Method SW7841

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
SW7841	Thallium	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.29-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD $> \text{UCL}$ or (2)%R for MS or MSD $< \text{LCL}$ or (3)MS/MSD RPD $> \text{CL}$
		MDL study	Once per year	Detection limits established shall be $<$ the PQLs in Table 7.2.29-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.30 Method SW7911-Graphite Furnace Atomic Absorption (Vanadium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Vanadium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.30-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.30-2 and 7.2.30-3.

Table 7.2.30-1. PQLs for Method SW7911

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7911 (W)	Vanadium	0.004	mg/L	0.4	mg/kg
SW3050A/SW7911 (S)					

Table 7.2.30-2. QC Acceptance Criteria for Method SW7911

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7911	Vanadium	78-123	≤ 15	78-123	≤ 25

Table 7.2.30-3. Summary of Calibration and QC Procedures for Method SW7911

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW7911	Vanadium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.30-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
SW7911	Vanadium	LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.30-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.30-3. Summary of Calibration and QC Procedures for Method SW7911

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
SW7911	Vanadium	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.30-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.30-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.31 Method SW9010A/SW9012-Total Cyanide and Cyanide Amenable to Chlorination

Water and waste samples are analyzed for total cyanide using method SW9010A or SW9012. These methods are equivalent in principle of analysis; SW9010A is a manual procedure, and SW9012 is an automated procedure.

Both methods are used to determine the concentration of inorganic cyanide in aqueous wastes and leachates. The methods detect inorganic cyanides that are present as either sample soluble salts or complex radicals. It is used to determine values for both total cyanide and cyanide amenable to chlorination. The cyanide is released by refluxing the sample with a strong acid and catalyst and distillation. Total cyanide in soils is determined after acidification of the soil and distillation. The cyanide ion in the absorbing solution is then determined by spectrophotometry for method SW9010A and by automated colorimetry for method SW9012. PQLs for cyanide are listed in Table 7.2.31-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.31-2 and 7.2.31-3.

Table 7.2.31-1. PQLs for Method SW9010A/SW9012

Parameter/Method	Analyte	Water	
		PQL	Unit
SW9010A/SW9012	Total cyanide	0.02	mg/L

Table 7.2.31-2. QC Acceptance Criteria for Method SW9010A/SW9012

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)
SW9010A SW9012	Total cyanide	79-114	≤ 20

Table 7.2.22-3. Summary of Calibration and QC Procedures for Method SW9010A/SW9012

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW9010A/ SW9012	Cyanide	Multipoint calibration curve (six standards and a calibration blank)	Initial daily calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to the result for cyanide for all samples associated with the calibration
		Distilled standards (one high and one low)	Once per multipoint calibration	Cyanide within $\pm 15\%$ of undistilled standard	Correct problem then repeat distilled standards	Apply R to all results for the specific analyte for all samples associated with the calibration
		Second-source calibration verification	Once per stock standard preparation	Cyanide within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to the result for the specific analyte for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.22-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to the specific analyte result for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to the result for the specific analyte in all samples in the associated analytical batch
SW9010A/ SW9012	Cyanide	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.22-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For the specific analyte in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 7.2.22-3. Summary of Calibration and QC Procedures for Method SW9010A/SW9012

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.22-2	none	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.22-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.32 Method SW9056—Common Anions

This method addresses the sequential determination of the anions chloride, fluoride, bromide, nitrate, nitrite, phosphate, and sulfate in the collection solutions from the bomb combustion of solid waste samples, as well as water samples.

A small volume of combustate collection solution or other water sample is injected into an ion chromatograph to flush and fill a constant volume sample loop. The sample is then injected into a stream of eluent.

The sample is pumped through three different ion exchange columns and into a conductivity detector. The first two columns, a precolumn (guard) column and a separator column, are packed with a low-capacity, strongly basic anion exchanger. Ions are separated into discrete bands based on their affinity for the exchange sites of the resin. The last column is a suppressor column that reduces the anions in the sample to their corresponding acids. The separated anions in their acid form are measured using an electrical-conductivity cell. Anions are identified based on their retention times compared to known standards. Quantitation is accomplished by measuring the peak height or area and comparing it to a calibration curve generated from known standards.

PQLs are listed in Table 7.2.32-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.32-2 and 7.2.32-3.

Table 7.2.32-1. PQLs for Method SW9056

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Common Anions SW9056	Bromide	0.1	mg/L	0.1	mg/kg
	Chloride	0.2	mg/L	0.2	mg/kg
	Fluoride	0.2	mg/L	0.2	mg/kg
	Nitrate	0.1	mg/L	0.1	mg/kg
	Nitrite	0.4	mg/L	0.1	mg/kg
	Phosphate	0.1	mg/L	0.1	mg/kg
	Sulfate	0.2	mg/L	0.2	mg/kg

Table 7.2.32-2. QC Acceptance Criteria for Method SW9056

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW9056	Bromide	86-112	≤ 20	86-112	≤ 30
	Chloride	91-111	≤ 20	91-111	≤ 30
	Fluoride	86-114	≤ 20	86-114	≤ 30
	Nitrate	90-110	≤ 20	90-110	≤ 30
	Nitrite	88-116	≤ 20	88-116	≤ 30
	Phosphate	87-110	≤ 20	87-110	≤ 30
	Sulfate	88-115	≤ 20	88-115	≤ 30

Table 7.2.32-3. Summary of Calibration and QC Procedures for Method SW9056

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW9056	Common anions	Multipoint calibration for all analytes (minimum 3 standards and one calibration blank)	Initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per multipoint calibration	All analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis or when eluent is changed	All analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	Instrument response within $\pm 5\%$ of expected response	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
			After every analytical batch	All analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
SW9056	Common anions	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.32-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

Table 7.2.32-3. Summary of Calibration and QC Procedures for Method SW9056

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.32-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
SW9056	Common anions	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.32-2	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.32-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

- All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
- Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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8.0 DATA REDUCTION, REVIEW, VERIFICATION, REPORTING, VALIDATION, AND RECORDKEEPING

The data reduction, review, reporting, and validation procedures described in this section will ensure; (1) complete documentation is maintained, (2) transcription and data reduction errors are minimized, (3) the data are reviewed and documented, and (4) the reported results are qualified if necessary. Laboratory data reduction and verification procedures are required to ensure the overall objectives of analysis and reporting meet method and project specifications.

8.1 DATA REVIEW, VALIDATION, AND REPORTING REQUIREMENTS FOR SCREENING DATA

The analysts shall perform a 100 percent review of the screening data. The screening data methods are identified in Table 6-1 of Section 6. All screening data shall be qualified with an *S* flag and shall be further qualified if critical calibration and QC requirements are not acceptable. The calibration, QC requirements, corrective action requirements, and flagging criteria required are shown in Table 6.2-1 in Section 6. The flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed. "S" designator flags shall be maintained in the final data qualification. When the data are reviewed and qualified, the analyst shall apply a final qualifier to any data that has been affected by multiple qualifiers. This final qualifier shall reflect the most severe qualifier that was applied to the data. The allowable final data qualifiers for screening data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are *SR*, *SJ*, *SB*, and *SU*. Therefore, the allowable final data qualifiers for screening data are *SR*, *SJ*, *SB*, *SU*, and *S*.

The definition of the data qualifiers are shown in Table 8.2-1. A summary of the flagging conventions of field screening methods is given in Table 6.2-1.

Screening data report packages shall be prepared for all field analyses as described in Section 8.8. The screening data shall be reported on the AFCEE screening data report forms (AFCEE Forms S-1 through S-3), as illustrated in Section 8.8. The prime contractor's project manager shall review the entire screening data report package with the field records. The prime contractor (1) shall determine if the data quality objectives have been met, and (2) shall calculate the data completeness for the project. These results shall be included in the data package deliverable.

8.2 DATA REVIEW, VALIDATION, AND REPORTING REQUIREMENTS FOR DEFINITIVE DATA

In each laboratory analytical section, the analyst performing the tests shall review 100 percent of the definitive data. After the analyst's review has been completed, 100 percent of the data shall be reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria.

The definitive data methods are identified in Section 7.2. The calibration, QC requirements, corrective action requirements, and flagging criteria required for definitive data are shown in the tables in Section 7.2, and in summary Tables 8.2-2, 8.2-3, and 8.2-4. The flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

Data qualifiers shall be added by the laboratory supervisor of the respective analytical section, after the first and second level of laboratory data reviews have been performed. Analytical batch comments shall be added to the first page of the definitive data report packages to explain any nonconformance or other issues. When data are qualified, the laboratory supervisor shall apply a final qualifier to any data that have been affected by multiple qualifiers. This final qualifier shall reflect the most severe qualifier that was applied to the data, i.e., all data will have only one data qualifying flag associate with it. The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are *R*, *M*, *F*, *J*, *B*, and *U*. The definitions of the data qualifiers are shown in Table 8.2-1.

The one exception to these data flagging criteria rules applies to the tentatively identified compounds (TICs) that are identified only in the GC/MS methods. These TICs numerical results will always be qualified with one and only one flag for any reason, and that is the "T" flag.

The laboratory QA section shall review 10 percent of the completed data packages, and the laboratory project manager shall perform a sanity check review on all the completed data packages.

The prime contractor's project manager shall review the entire definitive data report package, and with the field records, apply the final data qualifiers for the definitive data. The laboratory shall apply data qualifying flags to each environmental field QC sample, e.g., ambient blanks, equipment blanks, trip blanks, field duplicates, matrix spike (MS) samples, and matrix spike duplicate (MSD) samples. The prime contractor shall review the field QC samples and field logs, and shall then appropriately flag any of the associated samples identified with the field QC sample, as explained in Table 8.2-2 and-3. For example, each matrix spike sample would only be qualified by the laboratory, while the prime contractor would apply the final

qualifying flag for a matrix effect to all samples collected from the same site as the parent sample, Table 8.2-2.

The prime contractor (1) shall determine if the data quality objectives have been met, and (2) shall calculate the data completeness for the project. These results shall be included in the data package deliverable as described in Section 8.8.

Table 8.2-1 Data Qualifiers

Qualifier	Description
J	The analyte was positively identified, the quantitation is an estimation.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the MDL.
F	The analyte was positively identified but the associated numerical value is below the PQL.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.
S	To be applied to all field screening data.
T	Tentatively identified compound (using GC/MS)

Table 8.2-2. General Flagging Conventions

QC Requirement	Criteria	Flag	Flag Applied To
Holding Time	Time exceeded for extraction or analysis	R	All analytes in the sample
LCS	% R > UCL %R < LCL	J for the positive results J for the positive results, R for the nondetects	The specific analyte(s) in all samples in the associated analytical batch
Method Blank	Analyte(s) detected > PQL	B	The specific analyte(s) in all samples in the associated analytical batch
Equipment Blank	Analyte(s) detected > PQL	B	The specific analyte(s) in all samples with the sampling date
Field duplicates	Field duplicates > PQLs AND RPD outside CL	J for the positive results R for the nondetects	The specific analyte(s) in all samples collected on the same sampling date
MS/MSD	MS or MSD % R > UCL OR MS or MSD % R < LCL OR MS/MSD RPD > CL	M for all results	The specific analyte(s) in all samples collected from the same site as the parent sample
Sample Preservation/ Collection	Preservation/collection requirements not met	R for all results	All analytes in the sample
Sample Storage	< 2°C or > 6°C	J for the positive results R for the nondetects	All analytes in the sample
Quantitation	Analyte(s) detected ≥ MDL but < PQL	F	All affected results

UCL = upper control limit
LCL = lower control limit
CL = control limit

Table 8.2-3. Flagging Conventions Specific to Organic Methods

QC Requirement	Criteria	Flag	Flag Applied To
Ambient Blank (VOC samples only)	Analyte(s) detected > PQL	B	The specific analyte(s) in all samples with the same matrix and sampling date
Trip Blank (VOC samples only)	Analyte(s) detected > PQL	B	The specific analyte(s) in all samples shipped in the same cooler.
Initial Five Point Calibration (GC methods)	RSD > CL	R for all results	The specific analyte(s) in the sample associated with the calibration
Initial Five Point Calibration (GC/MS methods)	SPCC criteria not met	R for all results	All analytes in all samples associated with the calibration
Second Source Calibration Verification (GC and GC/MS methods)	RF outside \pm CL	R for all results	The specific analyte(s) in the sample associated with the calibration
Initial Daily Calibration Verification (GC methods)	RF outside \pm CL	R for all results	The specific analyte(s) in the sample associated with the calibration
Initial Daily Calibration Verification (GC/MS methods)	SPCC and CCC criteria not met	R for all results	The specific analyte(s) in the sample associated with the calibration
	RF outside \pm CL	R for specific results	All analytes in all samples associated with the calibration
Continuing Calibration (GC methods)	RF outside \pm CL	R for all results	The specific analyte(s) in the sample associated with the calibration
Retention time	Retention time of analyte outside of established retention time window	R	The specific analyte(s) in the samples
Surrogates	any surrogate % R > UCL	J for the positive results	All analytes in the sample
	OR		
	any surrogate % R < LCL	J for the positive results	
	OR		
	any surrogate recovery < 10%	R for the nondetects	
		R for all results	
Mass Spectrometer Tune	Ion abundance criteria not met	R for all results	All analytes in all samples associated with the tune
Tentatively Identified Compounds (TICs)		J	All TICs

UCL = upper control limit

LCL = lower control limit

CL = control limit

Table 8.2-4. Flagging Conventions Specific to Inorganic Methods

QC Requirement	Criteria	Flag	Flag Applied To
Initial multipoint calibration	Correlation coefficient \leq 0.995	R	All results for specific analyte(s) for all samples associated with the calibration
Highest calibration standard	result not within 95–105% of expected value	R	All results for specific analyte(s) for all samples associated with the calibration
Calibration blank	not within ± 3 standard deviations of mean blank value	B	All results for specific analyte(s) in all samples associated with the blank
Continuing calibration verification (Instrument Check Standard)	result not within 90–110% of expected value	R	All results for the specific analyte(s) in all samples since the last acceptable calibration
Interference check solution (ICS)	result not within 80–120% of expected value	R	All results for specific analyte(s) in all samples associated with the ICS
Dilution test	dilution not within 90–110% of the original determination	J	Apply to all sample results if the new matrix check was not run or RPD $\geq 10\%$
New matrix check	result $> 10\%$ of original result	J	All samples in digestion batch if analytical spike not performed
Recovery test	% R not within 85–115% of expected value	J	All samples in digestion batch if method of standard addition is not performed
Post digestion spike addition	% R of expected value not within 75–125%	J	All sample results (for same matrix) for specific analyte(s) for all samples associated with the post digestion spike addition
Second source calibration verification	RPD outside \pm CL	R	All samples
Method of standard addition	Method of standard addition not done OR Method of standard addition spike levels inappropriate OR correlation coefficient < 0.995	J to all positive results	Sample

UCL = upper control limit

LCL = lower control limit

CL = control limit

8.3 QUALITY ASSURANCE REPORTS

The laboratory QA staff shall issue QA reports to the laboratory management, laboratory supervisors and task leaders. These reports shall describe the results of QC measurements, performance audits, and systems audits, and confirmation sample comparisons performed for each sampling and analysis task. Quality problems associated with performance of methods, completeness of data, comparability of data including field and confirmatory data, and data storage shall be documented with the corrective actions that have been taken to correct the deficiencies identified.

8.4 IRPIMS ELECTRONIC DATA REPORTS

The prime contractor shall provide an electronic deliverable report in the Installation Restoration Program Information Management System (IRPIMS) format as specified by the SOW for the project.

IRPIMS is a data management system designed to accommodate all types of data collected for IRP projects. Specific codes and data forms have been developed to allow consistent and efficient input of information to the system. The database information shall be provided by the prime contractor via ASCII files in specified IRPIMS format on 3.5" floppy diskettes. The information transferred shall include all required technical data such as site information; well characteristics; and hydrogeologic, geologic, physical, and chemical analysis results. Electronic data reporting formats and requirements are given in the most current version of the *IRPIMS Data Loading Handbook*.

8.5 ARCHIVING

Hardcopy and electronic data shall be archived in project files and on electronic archive tapes for the duration of the project or a minimum of five years, whichever is longer.

8.6 PROJECT DATA FLOW AND TRANSFER

The data flow from the laboratory and field to the project staff and data users shall be sufficiently documented to ensure the data are properly tracked, reviewed, and validated for use.

8.7 RECORDKEEPING

The laboratory shall maintain electronic and hardcopy records sufficient to recreate each analytical event conducted pursuant to the SOW. The minimum records the laboratory shall keep contain the following: (1) COC forms, (2) initial and continuing

calibration records including standards preparation traceable to the original material and lot number, (3) instrument tuning records (as applicable), (3) method blank results, (4) IS results, (5) surrogate spiking records and results (as applicable), (6) spike and spike duplicate records and results, (7) laboratory records, (8) raw data, including instrument printouts, bench work sheets, and/or chromatograms with compound identification and quantitation reports, (9) corrective action reports, (10) other method and project required QC samples and results, and (11) laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples.

8.8 HARDCOPY DATA REPORTS FOR SCREENING AND DEFINITIVE DATA

The hardcopy data reports shall conform to the formats identified in this section.

A screening data report package shall consist of the following AFCEE forms: S-1, S-2, and S-3.

A definitive data inorganic report package shall consist of the following AFCEE forms: I-1, I-2, I-3, I-4, I-5, I-6, I-7, I-8 and I-9.

A definitive data organic report package shall consist of the following AFCEE forms: O-1, O-2, O-3, O-4, O-5, O-6, O-7, O-8, O-9 and O-10.

Exceptions to these report forms are as follows: for mercury analysis, form I-3A will be substituted for form I-3 in the inorganic report package; for cyanide analysis, form I-3B will be substituted for form I-3 in the inorganic report package; for GC/MS analyses, form O-5A will be added to the organic report package.

INSTRUCTIONS FOR COMPLETING AFCEE REPORT FORMS

The following instructions shall be used in completing the AFCEE report forms for screening and definitive data. The bold lettering identifies the fields on the AFCEE report form.

ALL INORGANIC AND ORGANIC FORMS

Analytical Method: enter the method name (e.g., SW6010A, SW8270B)

AAB#: enter the unique AFCEE analytical batch number (see Section 4.4 of the AFCEE QAPP for a definition of a batch)

Lab Name: enter the laboratory name (e.g., Garland Labs, Inc.)

Contract #: enter the Air Force contract number and delivery order number under which the analytical work is being performed (e.g., F21625-94-D-8005/0001)

Comments: any comments

FORM I-1

Base/Command: enter the base name and the Air Force command (e.g., Banks AFB/SPACECOM)

Prime Contractor: enter the name of the prime contractor (e.g., RDS, Inc)

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

FORM I-2

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

Matrix: enter the sample matrix (e.g., water, soil)

FORM I-2 (continued)

% Solids: enter the % solids

Dilution: enter the dilution (if applicable) (e.g., 1:5)

Date Received/Extracted/Analyzed: enter the appropriate dates in the format DD-MMM-YY (e.g., 3 Jun 96)

Concentration Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

MDL: enter the laboratory derived method detection limit

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance for each analyte

Concentration: enter the result

Qualifier: enter the qualifier flag (see QAPP Sections 7 and 8)

FORM I-3

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

RF Blank, RF1, RF2, RF3: enter the response factor corresponding to the standard with the same number: RF Blank is the response factor for the blank

Std 1, Std2, Std3: enter the concentration of the standard

r: enter the correlation coefficient

Q: enter a "*" for all corresponding correlation coefficients that were not acceptable as per QAPP Section 7

FORM I-3A (Mercury analyses only) and I-3B (cyanide analyses only)

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

FORM I-3A and I-3B (continued)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

RF Blank, RF1, RF2, RF3, RF4, RF5, RF6: enter the response factor corresponding to the standard with the same number: RF Blank is the response factor for the blank

Std 1, Std 2, Std 3, Std 4, Std 5, Std 6: enter the concentration of the standard

r: enter the correlation coefficient

Q: enter a "*" for all corresponding correlation coefficients that were not acceptable as per QAPP Section 7

FORM I-4

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

Highest Std ID: enter the unique identifier for the highest standard such that the standard could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., HS960603)

2nd Source ID: enter the unique identifier for the 2nd source standard such that the standard could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., 2S960603)

CCV #1 ID: enter the unique identification number for the first CCV such that the CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-1)

CCV #2 ID: enter the unique identification number for the second CCV such that the CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-2)

Expected, Expected 1: enter the expected result (i.e., the concentration of the calibration material)

Found, Found 1, Found 2: enter the measured result

FORM I-4 (continued)

%D: enter the per cent difference between the expected and found

Q: enter a "*" for all %Ds that were not acceptable as per QAPP Section 7

FORM I-5

Units: enter the appropriate units (i.e., µg/L or mg/kg)

Calibration Blank ID: enter the identification number for the calibration blank (the same ID number will be found in the run sequence log, e.g., CB960603)

Method Blank ID: enter the identification number for the method blank (the same ID number will be found in the run sequence log, e.g., MB960603)

CCB #1 ID: enter the identification number for the first CCB (the same ID number will be found in the run sequence log, e.g., CCB960603-1)

CCB #2 ID: enter the identification number for the second CCB (the same ID number will be found in the run sequence log, e.g., CCB960603-2)

CCB #3 ID: enter the identification number for the third CCB (the same ID number will be found in the run sequence log, e.g., CCB960603-3)

Calibration Blank: enter the result for the calibration blank

Continuing Calibration Blank 1: enter the result for the continuing calibration blank 1

Continuing Calibration Blank 2: enter the result for the continuing calibration blank 2

Continuing Calibration Blank 3: enter the result for the continuing calibration blank 3

Method Blank: enter the result for the method blank

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance for each analyte

Q: enter a "*" for all calibration and method blank analytes that were not acceptable as per QAPP Section 7

FORM I-6

LCS ID: enter the unique identification number for the laboratory control sample such that the LCS could be traced back to its source material (the same ID number will be found in the run sequence log e.g., LCS960603)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

Expected: enter the expected result (i.e., the concentration of the calibration material)

Found: enter the measured result

%R: enter the per cent difference between the expected and found

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter a "*" for all %Rs that were not acceptable as per QAPP Section 7

FORM I-7

Parent Field Sample ID: enter the field sample ID of the parent sample (the sample spiked for the MS and MSD)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

% Solids: enter the % solids

MS ID: enter the unique identification number for the matrix spike such that the MS could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log e.g., MS960603)

MSD ID: enter the unique identification number for the matrix spike duplicate such that the MSD could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log e.g., MSD960603)

Parent Sample Result: enter the result of the parent sample

Spike Added: enter the amount of spike added to the parent sample

Spike Sample Result: enter the result of the MS

%R: enter the per cent recovery

FORM I-7 (continued)

Duplicate Spike Sample Result: enter the result of the MSD

%RPD: enter the relative per cent difference between the spike (MS) and spike duplicate (MSD)

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter the qualifier flag as needed (see QAPP Sections 7 and 8)

FORM I-8

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Date Collected: enter the date the sample was taken in the field in the format DD-MMM-YY (e.g., 6 Jun 96)

Date Received: enter the date the sample was received at the laboratory in the format DD-MMM-YY (e.g., 6 Jun 96)

Date Analyzed: enter the date the sample was analyzed by the laboratory in the format DD-MMM-YY (e.g., 6 Jun 96)

Max. Holding Time: enter the maximum allowable holding time in days (see QAPP Section 5)

Time Held: enter the time in days elapsed between the date collected and the date analyzed

Q: enter a "*" for all holding times that were greater than the maximum allowable holding time as per QAPP Section 5

FORM I-9

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Field Sample ID/Std ID/Blank ID/QC Sample ID: enter the unique identifying number of each sample (environmental sample, standard, blank, LCS, MS, MSD, etc.) in the sequence they were analyzed

FORM I-9 (continued)

Date Analysis Started: enter the date the sample analysis was started in the format DD-MMM-YY (e.g., 6 Jun 96)

Time Analysis Started: enter the time the sample analysis was started in 24 hour format (e.g., 0900, 2130)

Date Analysis Completed: enter the date the sample analysis was completed in the format DD-MMM-YY (e.g., 6 Jun 96)

Time Analysis Completed: enter the time the sample analysis was completed in 24 hour format (e.g., 0900, 2130)

FORM O-1

Base/Command: enter the base name and the Air Force command (e.g., Banks AFB/SPACECOM)

Prime Contractor: enter the name of the prime contractor (e.g., RDS, Inc)

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

FORM O-2

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

Matrix: enter the sample matrix (e.g., water, soil)

% Solids: enter the % solids

Dilution: enter the dilution (if applicable) (e.g., 1:5)

FORM O-2 (continued)

Date Received/Extracted/Analyzed: enter the appropriate dates in the format DD-MMM-YY (e.g., 3 Jun 96)

Concentration Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

MDL: enter the laboratory derived method detection limit

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance for each analyte

Concentration: enter the result

Qualifier: enter the qualifier flag as needed (see QAPP Sections 7)

FORM O-3

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Compound: enter BFB or DFTPP as appropriate

Injection Date/Time: enter the date (in the format DD-MMM-YY) and time (in 24 hour format) of the performance check

Mass: enter the mass of the ion used for tuning (see QAPP Section 7)

Ion Abundance Criteria: enter the criteria for the specific mass (see QAPP Section 7)

% Relative Abundance: enter the per cent relative abundance as the result of the tune

Q: enter a "*" for all % relative abundance results that were not acceptable as per QAPP Section 7

Field Sample ID/Std ID/Blank ID/QC Sample ID: enter the unique identifying number of each sample (environmental sample, standard, blank, LCS, MS, MSD, etc.)

Date Analyzed: enter the date the sample was analyzed by the laboratory in the format DD-MMM-YY (e.g., 3 June 96)

FORM O-3 (continued)

Time Analyzed: enter the time the sample was analyzed by the laboratory in 24 hour format (e.g., 0900, 2130)

FORM O-4

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

Calibration ID: enter the unique identifier for the specific calibration event

RF Blank, RF1, RF2, RF3, RF4, RF5: enter the response factor corresponding to the standard with the same number. RF Blank is the response factor for the blank

Std 1, Std 2, Std 3, Std 4, Std 5: enter the concentration of the standard

%RSD: enter the per cent relative standard deviation

Q: enter a "*" for all % RSDs that were not acceptable as per QAPP Section 7

FORM O-5

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

2nd Source ID: enter the unique identifier for the 2nd source standard such that the standard could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., 2S960603)

CCV #1 ID: enter the unique identification number for the first CCV such that the CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-1)

CCV #2 ID: enter the unique identification number for the second CCV such that the second CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-2)

FORM O-5 (continued)

Expected, Expected 1: enter the expected result (i.e., the concentration of the calibration material)

Found, Found 1, Found 2: enter the measured result

%D: enter the per cent difference between the expected and found

Q: enter a "*" for all % Ds that were not acceptable as per QAPP Section 7

FORM O-5A

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

SPCC #1 ID: enter the unique identification number for the SPCC associated with the initial multipoint calibration such that the SPCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., SPCC960603-1)

SPCC #2 ID: enter the unique identification number for the SPCC associated with the daily calibration such that the SPCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., SPCC960603-2)

SPCC #2 ID: enter the unique identification number for the SPCC run after 12 hours of operation such that the SPCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., SPCC960603-3)

CCC #2 ID: enter the unique identification number for the CCC associated with the daily calibration such that the CCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCC960603-2)

CCC #2 ID: enter the unique identification number for the CCC run after 12 hours of operation such that the CCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCC960603-3)

FORM O-5 (continued)

RF: enter the response factor

Min RF: enter the minimum acceptable response factor (see QAPP Section 7)

Expected: enter the expected result (i.e., the concentration of the calibration material)

Found: enter the measured result

%D: enter the per cent difference between the expected and found

Q: enter a "*" for (1) any % Ds that were not acceptable or (2) any RFs not meeting minimum acceptable requirements as per QAPP Section 7

FORM O-6

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

Method Blank ID: enter the unique identification number for the method blank (the same ID number will be found in the run sequence log, e.g., MB960603)

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 7 of the QAPP)

Method Blank: enter the result for the method blank

PQL: enter the project practical quantitation limit as stated in this QAPP or approved variance for each analyte

Q: enter a "*" for all method blank analyte results that were not acceptable as per QAPP Section 7

FORM O-7

LCS ID: enter the unique identification number for the laboratory control sample such that the LCS could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., LCS960603)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

FORM Q-7 (continued)

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 7 of the QAPP)

Expected: enter the expected result (i.e., the concentration of the calibration material)

Found: enter the measured result

%R: enter the per cent recovery

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter a "*" for all % Rs that were not acceptable as per QAPP Section 7

FORM Q-8

Parent Field Sample ID: enter the field sample ID of the parent sample (the sample spiked for the MS and MSD)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

% Solids: enter the % solids

MS ID: enter the unique identification number for the matrix spike such that the MS could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log, e.g., MS960603)

MSD ID: enter the identification number for the matrix spike duplicate such that the MSD could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log, e.g., MSD960603)

Parent Sample Result: enter the result of the parent sample

Spike Added: enter the amount of spike added to the parent sample

Spike Sample Result: enter the result of the MS

%R: enter the per cent recovery

Duplicate Spike Sample Result: enter the result of the MSD

FORM O-8 (continued)

%RPD: enter the relative per cent difference between the spike (MS) and spike duplicate (MSD)

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter the qualifier flag as needed (see QAPP Sections 7)

FORM O-9

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Date Collected: enter the date the sample was taken in the field in the format DD-MMM-YY (e.g., 3 Jun 96)

Date Received: enter the date the sample was received at the laboratory in the format DD-MMM-YY (e.g., 3 Jun 96)

Date Extracted: enter the date the sample was extracted by the laboratory in the format DD-MMM-YY (e.g., 3 Jun 96)

Max. Holding Time E: enter the maximum allowable holding time in days until the sample is extracted (see QAPP Section 5)

Time Held Ext.: enter the time in days elapsed between the date collected and the date extracted

Date Analyzed: enter the date the sample was analyzed by the laboratory in the format DD-MMM-YY (e.g., 3 Jun 96)

Max. Holding Time A: enter the maximum allowable holding time in days until the sample is analyzed (see QAPP Section 5)

Time Held Anal.: enter the time in days elapsed between the date collected and the date analyzed

Q: enter a "*" for all holding times (Max. Holding Time E, or Max. Holding Time A, or Time Held Anal.) that were greater than the maximum holding time that were not acceptable as per QAPP Section 5

FORM O-10

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Field Sample ID/Std ID/Blank ID/QC Sample ID: enter the unique identifying number of each sample (environmental sample, standard, blank, LCS, MS, MSD, etc.) in the sequence they were analyzed

Date Analysis Started: enter the date the sample analysis was started in the format DD-MMM-YY (e.g., 3 Jun 96)

Time Analysis Started: enter the time the sample analysis was started in 24 hour format (e.g., 0900, 2130)

Date Analysis Completed: enter the date the sample analysis was completed in the format DD-MMM-YY (e.g., 3 Jun 96)

Time Analysis Completed: enter the time the sample analysis was completed in 24 hour format (e.g., 0900, 2130)

Form S-1

Base/Command: enter the base name and the Air Force command (e.g., Banks AFB/SPACECOM)

Prime Contractor: enter the name of the prime contractor (e.g., RDS, Inc)

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

FORM S-2

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Matrix: enter the sample matrix (e.g., water, soil)

Date Analyzed: enter the appropriate dates in the format DD-MMM-YY (e.g., 3 Jun 96)

Concentration Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

FORM S-2 (continued)

MDL: enter the laboratory derived method detection limit

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance for each analyte

Concentration: enter the result

Qualifier: enter the qualifier needed (see QAPP Sections 7 and 8)

FORM S-3

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

Sample Result: enter the result of the sample

Duplicate Sample Result: enter the result of the duplicate sample

%D or %RPD: enter the per cent or difference relative per cent difference between the sample and duplicate

Acceptance Criteria: enter the acceptance criteria required to be met (see QAPP Section 6)

Q: enter a "*" for all % Ds or % RPDs that were not acceptable as per QAPP Section 6

MDL FORM

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 7 of the QAPP)

Amt. Spiked: enter the amount of spike added to the parent sample

Replicate 1,2,3,4,5,6,7: enter the result of the replicate

Std. Dev.: enter the standard deviation of the seven replicates

MDL: enter the calculated MDL

CHAIN OF CUSTODY FORM

COC#: enter a unique number for each chain of custody form

Ship to: enter the laboratory name and address

Carrier: enter the name of the transporter (e.g., FedEx) or handcarried

Airbill#: enter the airbill number or transporter tracking number (if applicable)

Project Name: enter the project name (e.g., Banks AFB RI/FS)

Sampler Name: enter the name of the person collecting the samples

Sampler Signature: signature of the person collecting the samples

Send Results to: enter the name and address of the prime contractor

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Date: enter the year and date the sample was collected in the format M/D (e.g., 6/3)

Time: enter the time the sample was collected in 24 hour format (e.g., 0900)

Matrix: enter the sample matrix (e.g., water, soil)

Pres: enter the preservative used (e.g., HNO₃) or "none"

CHAIN OF CUSTODY FORM (continued)

Filtered/Unfilt.: enter "F" if the sample was filtered or "U" if the sample was not filtered

of Containers: enter the number of containers associated with the sample

MS/MSD: enter "X" if the sample is designated the MD/MSD

Analyses Requested: enter the method name of the analysis requested (e.g., SW6010A)

Comments: enter comments

Sample Condition Upon Receipt at Laboratory: enter any problems with the condition of any sample(s)

Cooler Temperature: enter the internal temperature of the cooler, in degrees C, upon opening

Special Instructions/Comments: enter any special instructions or comments

Released by: (SIG): enter the signature of the person releasing custody of the samples

Company Name: enter the company name employing the person releasing/ receiving custody

Received by: (SIG): enter the signature of the person receiving custody of the samples

Date: enter the date in the format M/D/YY (e.g., 6/3/96) when the samples were released/received

Time: enter the time in 24 hour format (e.g., 0900) when the samples were released/received

[illegible]

AFCEE FORM 1-2 Page ____ of ____

AFCEE
INORGANIC ANALYSES DATA SHEET 3
MERCURY INITIAL MULTIPOINT CALIBRATION

Analytical Method: _____ AAB #: _____
Lab Name: _____ Contract #: _____
Instrument ID: _____ Date of Calibration: _____

Analyte	RF Blank	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	r	Q
Mercury													

r = correlation coefficient

Comments:

AFCEE FORM I-3A

AFCEE
INORGANIC ANALYSES DATA SHEET 3
CYANIDE INITIAL MULTIPOINT CALIBRATION

Analytical Method: _____

AAB #: _____

Lab Name: _____

Contract #: _____

Instrument ID: _____

Date of Calibration: _____

Analyte	RF Blank	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	Std 6	RF 6	r	Q
Cyanide															

r = correlation coefficient

Comments:

AFCEE FORM I-3B

AFCEE FORM I-4

AFCEE FORM 1-5

LCS ID: _____ Units: _____

[illegible]

AFCEE FORM I-6

[illegible]

AFCEE FORM I-7

Instrument ID #: _____

[illegible]

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AAB #: _____

Contract #: _____

Date of Calibration: _____

Calibration ID: _____

Comments:

[illegible]

Units: _____ Method Blank ID: _____

[illegible]

Lab Name: _____ Contract #: _____

[illegible]

AFCEE
SCREENING DATA PACKAGE

Analytical Method: _____ Contract #: _____

Base/Command: _____ Prime Contractor: _____

Field Sample ID

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Comments:

Signature: _____ Name: _____

Date: _____ Title: _____

AFCEE FORM S-1

Concentration Units ($\mu\text{g/L/L}$ or mg/kg dry weight): _____[illegible]

AFCEE FORM S-2 Page 1 of 1

Units: _____

[illegible]

Comments:

Ship to:	Project Name:		Send Results to:
	Sampler Name:		
	Sampler Signature:		
Carrier:	Airbill #:		

[illegible]

Sample Condition Upon Receipt at Laboratory:

Special Instructions/Comments:

#1 Released by: (Sig)	Date:	#2 Released by: (Sig)	Date:	#3 Released by: (Sig)	Date:
Company Name:	Time	Company Name:	Time	Company Name:	Time
#1 Received by: (Sig)	Date	#2 Received by: (Sig)	Date	#3 Received by: (Sig)	Date
Company Name:	Time:	Company Name:	Time:	Company Name:	Time:

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9.0 SYSTEMS AND PERFORMANCE AUDITS, PERFORMANCE EVALUATION PROGRAMS, MAGNETIC TAPE AUDITS, AND TRAINING

Technical systems and performance audits shall be performed as independent assessments of sample collection and analysis procedures. Audit results will be used to evaluate the ability of an analytical contractor to (1) produce data that fulfill the objectives established for the program, (2) comply with the QC criteria, and (3) identify any areas requiring corrective action. The systems audit is a qualitative review of the overall sampling or measurement system, while the performance audit is a quantitative assessment of a measurement system. Full data validation is also a quantitative check of the analytical process, where all documentation and calculations are evaluated and verified. Data validation is discussed in Section 8.

9.1 PROJECT AUDITS

9.1.1 State/Federal Project Audits

Audits by various state and federal agencies are commonly conducted for the laboratories that will analyze project samples. Audit reports from these agencies shall be reviewed by the prime contractor to determine whether data produced by the analytical contractor shall fulfill the objectives of the program.

Audit findings shall be transmitted to the prime contractor and to AFCEE. The prime contractor shall review the audit findings and provide a written report to AFCEE. This report shall include the recommended corrective actions or procedures to correct the deficiencies identified during the state/federal audits(s). The audit results and discussion shall be incorporated into the QA report for each sampling effort.

9.1.2 Technical Systems Audits

A technical systems audit is an on-site, qualitative review of the sampling or analytical system to ensure that the activity is being performed in compliance with the Sampling and Analysis Plan (SAP) specifications. Sampling and field procedures, and the analytical laboratories shall be audited by the prime contractor at the beginning of the field work. In addition, a laboratory systems audit shall be performed by AFCEE if previous audit reports indicate that corrective actions are outstanding, a recent audit has not been conducted, or quality concerns have arisen based upon the use of that laboratory for other projects. The laboratory systems audit results will be used to review laboratory operation and ensure the technical procedures and documentation are in place and operating to provide data that fulfill the project objectives and to ensure outstanding corrective actions have been addressed.

Critical items for a laboratory or field systems audit include: (1) sample custody procedures, (2) calibration procedures and documentation, (3) completeness of data forms, notebooks, and other reporting requirements, (4) data review and validation procedures, (5) data storage, filing, and record keeping procedures, (6) QC procedures, tolerances, and documentation, (7) operating conditions of facilities and equipment, (8) documentation of training and maintenance activities, (9) systems and operations overview, and (10) security of laboratory automated systems.

Critical items for a sampling systems audit include: (1) calibration procedures and documentation for field equipment, (2) documentation in field logbooks and sampling data sheets, (3) organization and minimization of potential contamination sources while in the field, (4) proper sample collection, storage, and transportation procedures, and (5) compliance with established COC and transfer procedures.

After each on-site audit, a debriefing session will be held for all participants to discuss the preliminary audit results. The auditor will then complete the audit evaluation and submit an audit report including observations of the deficiencies and the necessary recommendations for corrective actions. Compliance with the specifications presented in the SAP will be noted and noncompliance or deviations shall be addressed in writing by the prime contractor to AFCEE with corrective actions and a time frame for implementation of the corrective actions. Follow-up audits will be performed prior to completion of the project to ensure corrective actions have been taken.

9.1.3 Project-Specific Performance Evaluation Audits

Performance audits quantitatively assess the data produced by a measurement system. A performance audit involves submitting project-specific performance evaluation (PE) samples for analysis for each analytical method used in the project. The prime contractor shall submit project specific PE samples once per quarter per project. The project-specific PE samples are selected to reflect the expected range of concentrations for the sampling program. The performance audit answers questions about whether the measurement system is operating within control limits and whether the data produced meet the analytical QA specifications.

The project-specific PE samples are made to look as similar to field samples as possible and are submitted as part of a field sample shipment so that the laboratory is unable to distinguish between them and project samples. This approach ensures unbiased sample analysis and reporting by the laboratory.

The critical elements for review of PE results include: (1) correct identification and quantitation of the PE sample analytes, within project specifications, (2) accurate and complete reporting of the results, and (3) measurement system operation within established control limits for precision and accuracy.

The concentrations reported for the PE samples shall be compared to the known or expected concentrations spiked in the samples. The percent recovery shall be calculated and the results assessed according to the accuracy criteria for the LCS presented in Section 7. If the accuracy criteria are not met, the cause of the discrepancy shall be investigated and a second PE sample shall be submitted. The prime contractor shall notify the project staff, AFCEE, and agencies of the situation at the earliest possible time and the prime contractor shall keep AFCEE up to date regarding corrective actions and subsequent PE sample results.

9.1.4 Magnetic Tape Audits

Magnetic tape audits involve the examination of the electronic media used in the analytical laboratory and by the prime contractor to collect, analyze, report, and store data. These audits are used to assess the authenticity of the data generated, and assess the implementation of good automated laboratory practices. AFCEE shall perform magnetic tape audits of the laboratories or of the prime contractors when warranted by project PE results, on-site audit results, or by other state/federal investigations.

9.1.5 Performance Evaluation Sample Programs

All laboratories shall participate in the U.S. EPA PE Water Supply and Water Pollution Studies programs or equivalent programs for state certifications. Satisfactory performance in these nonproject-specific PE programs also demonstrate proficiency in methods used to analyze AFCEE samples. The laboratory shall document the corrective actions to unacceptable PE results to demonstrate resolution of the problems.

9.2 TRAINING

Training shall be provided to all project personnel to ensure compliance with the health and safety plan and technical competence in performing the work effort. Documentation of this training shall be maintained in the records of the contracted organizations.

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10.0 PREVENTIVE MAINTENANCE

A preventive maintenance program shall be in place to promote the timely and effective completion of a measurement effort. The preventive maintenance program is designed to minimize the downtime of crucial sampling and/or analytical equipment due to unexpected component failure. In implementing this program, efforts are focused in three primary areas: (1) establishment of maintenance responsibilities, (2) establishment of maintenance schedules for major and/or critical instrumentation and apparatus, and (3) establishment of an adequate inventory of critical spare parts and equipment.

10.1 MAINTENANCE RESPONSIBILITIES

Maintenance responsibilities for equipment and instruments are assumed by the respective facility managers. The managers then establish maintenance procedures and schedules for each major equipment item. This responsibility may be delegated to laboratory personnel, although the managers retain responsibility for ensuring adherence to the prescribed protocols.

10.2 MAINTENANCE SCHEDULES

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. Other maintenance activities are conducted as needed. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments (e.g., GC/mass spectrometry instruments, AA spectrometers, and analytical balances).

10.3 SPARE PARTS

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment downtime. The inventory includes those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur.

Field sampling task leaders and the respective laboratory managers are responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, the contractor shall maintain an in-house source of backup equipment and instrumentation.

10.4 MAINTENANCE RECORDS

Maintenance and repair of major field and laboratory equipment shall be recorded in field or laboratory logbooks. These records shall document the serial numbers of the equipment, the person performing the maintenance or repairs, the date of the repair,

the procedures used during the repair, and proof of successful repair prior to the use of the equipment.

11.0 CORRECTIVE ACTION

Requirements and procedures for documenting the need for corrective actions are described in this section.

11.1 CORRECTIVE ACTION REPORT

Problems requiring corrective action in the laboratory are documented by the use of a corrective action report. The QA coordinator or any other laboratory member can initiate the corrective action request in the event QC results exceed acceptability limits, or upon identification of some other laboratory problem. Corrective actions can include reanalysis of the sample or samples affected, resampling and analysis, or a change in procedures, depending upon the severity of the problem.

11.2 CORRECTIVE ACTION SYSTEM

A system for issuing, tracking, and documenting completion of formal Recommendations for Corrective Action (RCA) exists for addressing significant and systematic problems. Recommendations for corrective actions are issued only by a member of the QA group, or a designee in a specific QA role. Each RCA addresses a specific problem or deficiency, usually identified during QA audits of laboratory or project operations. An RCA requires a written response from the party to whom the RCA was issued. A summary of unresolved RCAs is included in the monthly QA report to management. The report lists all RCAs that have been issued, the manager responsible for the work area, and the current status of each RCA. An RCA requires verification by the QA group that the corrective action has been implemented before the RCA is considered to be resolved. In the event there is no response to an RCA within 30 days, or if the proposed corrective action is disputed, the recommendation and/or conflict is pursued to successively higher management levels until the issue is resolved.

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12.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

At a minimum, the QA coordinator shall prepare a summary report quarterly of the status of the project, of QA/QC problems, corrective actions taken, and unresolved RCAs with recommended solutions for management. The report shall also include results from all PE samples, audit findings, and periodic data quality assessments. This report shall be available for review by AFCEE auditors upon request.

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APPENDIX A

Exceptions to QAPP Procedures

This appendix includes information on Method E418.1 for total recoverable petroleum hydrocarbons. The Air Force does not recommend use of this method due to the interest in eliminating the use of ozone-depleting substances. The extraction process for Method E418.1 uses Freon-113, which is an ozone-depleting substance. However, the Texas Natural Resource Conservation Commission requires use of this method to characterize soils associated with petroleum storage tank removal. Jacobs will request Air Force approval to use Method E418.1 on this project.

Total Petroleum Hydrocarbons (TPH). Method E418.1 Oil and grease are removed from the sample with a series of freon (fluorocarbon-113) extractions. The extract is treated with silica gel to remove polar materials, leaving only the recoverable petroleum hydrocarbons. Method E418.1 is an infrared (IR) spectrophotometric analysis of TPH. Hydrocarbons include gasoline-range organics (GRO), diesel-range organics (DRO), and residual extractable hydrocarbons (motor oil and lubricants) and will be reported as a total concentration value in mg/kg. The Practical Quantitation Limit (PQL) is presented in Table A-1. The calibration, Quality Control (QC), corrective action, and data flagging requirements are given in Tables A-2 and A-3.

Table A-1
PQL for Method E418.1

Parameter	Method w = water s = soil	Analyte	Air Force Practical Quantitation Limit	
			Water (mg)	Soil/Sediment (mg/kg)
Total Petroleum Hydrocarbons	E418.1 (w & s)	TPH	1	30

Table A-2 QC Acceptance Criteria for Method E418.1

Method	Analyte	Accuracy Water (%R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
	Reference oil (n-hexadecane, isooctane, and chlorobenzene)	60-130	≤ 30	50-140	≤ 50

Table A-3 Summary of Calibration and QC Procedures for Method E418.1

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
E418.1	Total recoverable petroleum hydrocarbons	Three-point calibration for all analytes (initial calibration)	Initial calibration prior to sample analysis	Correlation coefficient (<i>r</i>) ≥ 0.995 for linear regression	Correct problem; repeat initial calibration	Apply R to all affected analytes associated with the calibration
		Continuing calibration verification	After every 10 samples	RFs within 10% (RPD) of average initial multipoint RF	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification	Apply R to all affected analytes associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table A-2	Recalculate results; locate and fix problem with system; rerun demonstration for those analytes that did not meet criteria	Apply R to all samples

Table A-3 Continued

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
E418.1 (Continued)	Total recoverable petroleum hydrocarbons (Continued)	Method blank	One per prep batch	No analytes detected > PQL	(1) Investigate source of contamination and correct problem (2) Reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all positive analytes if no method blank exists Apply B to all analytes that are identified in the method blank and in the samples at sample concentrations < 10x the blank concentration

Table A-3 Continued

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
E418.1 (Continued)	Total recoverable petroleum hydrocarbons (Continued)	LCS for all analytes	One LCS per prep batch	QC acceptance criteria, Table A-2	Correct the problem, then reprep and analyze all affected QC and field samples	Apply J to all positive affected analytes if any of the following exist: (1) LCS, %R > UCL (2) LCS, %R < LCL Apply R to all affected non-detects if LCS, %R < LCL Apply R to all affected analytes if any of the following exist: (1) LCS, %R < 10% (2) Minimum frequency not met

Table A-3 Continued

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
E418.1 (Continued)	Total recoverable petroleum hydrocarbons (Continued)	Surrogate spike	None			

Table A-3 Concluded

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a	Data Flagging Criteria
E418.1 (Concluded)	Total recoverable petroleum hydrocarbons (Concluded)	MS/MSD	One MS/MSD per every 20 Air Force project samples	QC acceptance criteria, Table A-2	None required	Apply J to all positive affected analytes if any of the following exist: (1) MS or MSD %R > UCL (2) RPD > UCL
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table A-1	Detection limits that exceed established criteria shall be submitted to the Air Force for approval prior to the analysis of any project samples	Apply J to all affected analytes if MS or MSD %R < LCL
		Results reported between MDL and PQL				Apply R to all positive analytes < PQL
						Apply F to all positive analytes

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

Method SW7520—Graphite Furnace Atomic Absorption (Nickel)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3005 or SW3050, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in μL amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the nickel. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. This method usually has a linear analysis range at the ppb or sub-ppb level. Reporting limits (PQLs) for these analyses are listed in Table A-4. The calibration, QC, corrective action, and data flagging requirements are given in Tables A-5 and A-6.

Table A-4 PQLs for Method SW7760

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7520	Nickel	0.01	mg/L	1.0	mg/kg

Table A-5 QC Acceptance Criteria for Method SW7520

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7520	Nickel	75-125	≤ 15	75-125	≤ 25

Table A-6 Summary of Calibration and QC Procedures for Method SW7520

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
SW7520	Nickel	Initial multipoint calibration (minimum of 3 standards and a calibration blank)	Daily initial calibration prior to sample analysis	Correlation coefficient (r) ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all sample results associated with the calibration
		Second-source calibration check standard	Once per initial multipoint calibration	Recovery within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all sample results associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analytes detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all positive sample results if no calibration blank exists. Apply B to all positive sample results if the sample concentration is < 10x the blank concentration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	Recovery within $\pm 20\%$ of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification	Apply R to all sample results in all samples since the last acceptable calibration

Table A-6 Continued

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ²	Data Flagging Criteria
SW75200 (Continued)	Nickel (Continued)	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table A-5	Recalculate results; locate and fix problem with system; rerun demonstration for those analytes that did not meet criteria	Apply R to all sample results
		Method blank	One per prep batch, Per matrix < 20 samples	No analyte detected > PQL	(1) Investigate source of contamination and correct problem (2) Reprep and analyze method blank and all associated samples processed with the contaminated blank (if contamination is detected in assoc. samples)	Apply B to all positive samples if no method blank exists Apply B to all sample results if the sample concentration is < 10x the blank concentration

Table A-6 Continued

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
SW7520 (Continued)	Nickel (Continued)	LCS for all analytes	One LCS per prep batch, per matrix, <20 samples	QC acceptance criteria, Table A-5	Correct the problem then reprep and analyze all affected QC and field samples	Apply J to all positive sample results if any of the following exist: (1) LCS % R > UCL (2) LCS % R < LCL
		MS/MSD	One MS/MSD per every 20 Air Force project samples, per matrix	QC acceptance criteria, Table A-5	Review LCS results to determine matrix interference	Apply R to all sample results if any of the following exist: (1) LCS % R < 10% (2) Minimum frequency not met
						Apply J to all positive samples if any of the following exist: (1) MS or MSD % R > UCL (2) RPD > UCL
						Apply J to all samples if MS or MSD % R < LCL

Table A-6 Concluded

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
SW7520 (Concluded)	Nickel (Concluded)	New matrix check; 1:4 dilution of samples	Each new sample matrix	1:4 dilution sample result must be within $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if any of the following exist: (1) New matrix check not run (2) RPD > 10%
		Recovery test	When new matrix check fails	Recovery within 85–115% of expected results	Run all affected samples by the method of standard addition	Apply J to all sample results if any of the following exist: (1) % R > 115% (2) % R < 85% (3) Method of standard addition not run (4) No recovery test was run
		MDL study	Once per year	Detection limits shall be < the PQLs given in Table A-4	Detection limits that exceed established criteria shall be submitted to the Air Force for approval prior to analysis of any project samples	Apply R to all positive samples < PQL
		Results reported between MDL and PQL				Apply F to all positive sample results

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

Method SW7760—Graphite Furnace Atomic Absorption (Silver)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3005 or SW3050, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in μL amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the silver. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. This method usually has a linear analysis range at the ppb or sub-ppb level. Reporting limits (PQLs) for these analyses are listed in Table A-7. The calibration, QC, corrective action, and data flagging requirements are given in Tables A-8 and A-9.

Table A-7 PQLs for Method SW7760

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7760	Silver	0.001	mg/L	0.1	mg/kg

Table A-8 QC Acceptance Criteria for Method SW7760

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7760	Silver	75-125	≤ 15	75-125	≤ 25

Table A-9 Summary of Calibration and QC Procedures for Method SW7760

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Data Flagging Criteria
SW7760	Silver	Initial multipoint calibration (minimum of 3 standards and a calibration blank)	Daily initial calibration prior to sample analysis	Correlation coefficient (<i>r</i>) ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all sample results associated with the calibration
		Second-source calibration check standard	Once per initial multipoint calibration	Recovery within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all sample results associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analytes detected > PQL	Correct problem then reanalyze calibration and all associated samples with blank	Apply B to all positive results if no calibration blank exists Apply B to all positive results if the sample concentration is < 10x the blank concentration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	Recovery within $\pm 20\%$ of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification	Apply R to all sample results in all samples since the last acceptable calibration

Table A-9 Continued

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Data Flagging Criteria
SW7760 (Continued)	Silver (Continued)	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table A-8	Recalculate results; locate and fix problem with system; rerun demonstration for those analytes that did not meet criteria	Apply R to all samples
		Method blank	One per prep batch, per matrix, <20 samples	No analyte detected > PQL	(1) Investigate source of contamination and correct the problem (2) Reprep and analyze method blank and all associated samples processed with the contaminated blank (if contamination is detected in the assoc. samples)	Apply B to all positive samples if no method blank exists Apply B to all sample results if the sample concentration is < 10x the blank concentration

Table A-9 Continued

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
SW7760 (Continued)	Silver (Continued)	LCS for all analytes	One LCS per prep batch, per matrix, <20 samples	QC acceptance criteria, Table A-8	Correct the problem, reprep, and analyze all affected QC and field samples	Apply J to all positive samples if any of the following exist: (1) LCS % R > UCL (2) LCS % R < LCL Apply R to all non-detects if LCS % R < LCL Apply R to all samples if any of the following exist: (1) LCS % R < 10% (2) Minimum frequency not met
		MS/MSD	One MS/MSD per every 20 Air Force project samples, per matrix	QC acceptance criteria, Table A-8	Review LCS results to determine matrix interference.	Apply J to all positive sample results if any of the following exist: (1) MS or MSD % R > UCL (2) RPD > UCL Apply J to all samples if MS or MSD % R < LCL

Table A-9 Concluded

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria
SW7760 (Concluded)	Silver (Concluded)	New matrix check; 1:4 dilution of samples	Each new sample matrix	1:4 dilution sample result must be within $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all samples if any of the following exist: (1) New matrix check not run (2) RPD > 10%
		Recovery test	When new matrix check fails	Recovery within 85–115% of expected results	Run all affected sample results by the method of standard addition	Apply J to all sample results if any of the following exist: (1) % R > 115% (2) % R < 85% (3) Method of standard addition not run (4) No recovery test was run
		MDL study	Once per year	Detection limits shall be < the PQLs given in Table A-7	Detection limits that exceed established criteria shall be submitted to the Air Force for approval prior to analysis of any project samples	Apply R to all positive sample results < PQL
		Results reported between MDL and PQL				Apply J to all positive sample results

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

Radium-226/Radium-228, Methods SW9315/SW9320 (modified for soil)

Method SW9315 will be required for all water samples with gross alpha activities (SW9130) exceeding 5.0 pCi/L.

These methods will be modified for soil matrix samples. A brief description of the modifications will be provided in the laboratory quality project plan (LQAPP).

Radium in water is collected by coprecipitation with barium and lead sulfate and purified by reprecipitation from an EDTA solution. Both radium-226 and radium-228 are collected in this manner. After a 36 hour ingrowth of actinium-228 from radium-228, the actinium-228 is carried on yttrium oxalate, purified and beta counted. The supernatant is reserved for coprecipitation on barium sulfate, dissolving in EDTA and storing ingrowth in a sealed radon bubbler. Reporting limits (PQLs) for these analyses are listed in Table A-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables A-2 and A-3.

Table A-10 PQLs for Method SW9315/SW9320

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW9315/9320	Radium-226/-228	1.0	pCi/L	0.5	pCi/g

Table A-11 QC Acceptance Criteria for Method SW9315/9320

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW9315/9320	Radium-226/-228	3 times the Std Deviation	NA	3 times the Std Deviation	NA

Table A-12 Summary of Calibration and QC Procedures for Method SW9315/9320

Analytical Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Data Flagging Criteria
SW9315/9320	Radium-226/-228	Multipoint calibration per instrument manufacturer's specifications	Annually	Instrument specifications	Repeat initial calibration	Apply R to all sample results
		Instrument Performance Verification	Daily	Standard statistical tests (Chi-squared or T-test)	Repeat initial calibration	Apply R to all sample results
		Laboratory blank	10% per batch	No analytes detected > PQLs given in Table A-10	Repeat blank	Apply B to all associated sample results for any blank contamination
		Barium Precipitation	All samples and QC must be corrected for recovery	Chemical recovery > 50%	Reprep all samples	Apply J to all associated samples
		LCS for all analytes	10% per batch. The LCS activity shall be >5X to ≤ 30X the PQL.	QC acceptance criteria, Table A-11	Reprep and analyze all affected QC and field samples	Apply J to all associated samples if LCS > 2 Std Deviations.
		Replicates	10% per batch	QC acceptance criteria: statistical function for testing equivalency	Repeat replicate.	Apply R to all associated samples if LCS > 3 Std. Deviations.
					Apply J to all sample results if outside the acceptance criteria.	

**ATTACHMENT 1
FIELD SAMPLING PLAN**

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PREFACE

This Field Sampling Plan (FSP) includes all field procedures for work to be conducted by Jacobs Engineering Group Inc. (Jacobs) for the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) and the background study at Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB), Carswell Field, Texas. This work is divided into three primary tasks: the Preliminary Assessment (PA)/RFI at Parcel D, the basewide background study, and the background study at the Weapons Storage Area (WSA). This field work is planned for July through September 1996.

The Jacobs project manager is Lynn Schuetter; the program manager is Warner Reeser. The Air Force Center for Environmental Excellence (AFCEE) Contracting Officer's Representative (COR) and Team Chief is Charles Rice. The point of contact at the Air Force Base Conversion Agency (AFBCA) is Olen Long.

This work is being conducted under contract F41624-94-D-8046, Delivery Order 21 issued to Jacobs by AFCEE.

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1.0 INTRODUCTION

The Field Sampling Plan (FSP) presents, in specific terms, the requirements and procedures for conducting field operations and investigations. This project specific FSP has been prepared to ensure (1) the data quality objectives specified for this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and defensible. This site specific FSP and the AFCEE Quality Assurance Project Plan (QAPP), shall constitute, by definition, an AFCEE Sampling and Analysis Plan (SAP).

The National Contingency Plan (NCP) specifies circumstances under which a FSP is necessary for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions. For cleanup actions at the remedial investigation/feasibility study (RI/FS) stage, the NCP requires lead agents to develop sampling and analysis plans which provide a process for obtaining data of sufficient quality and quantity to satisfy data needs. Such sampling and analysis plans must include a field sampling plan. 40 CFR 300.430 (b)(8)(ii).

Guidelines followed in the preparation of this plan are set out in the: *Data Quality Objectives Process for Superfund, Interim Final Guidance* (U.S. EPA, 1993).

This FSP is required reading for all staff participating in the work effort. The FSP shall be in the possession of the field teams collecting the samples. All contractors and subcontractors shall be required to comply with the procedures documented in this FSP in order to maintain comparability and representativeness of the collected and generated data.

Controlled distribution of the FSP shall be implemented by the prime contractor to ensure the current approved version is being used. A sequential numbering system shall be used to identify controlled copies of the FSP. Controlled copies shall be provided to applicable Air Force managers, regulatory agencies, remedial project managers, project managers, and quality assurance (QA) coordinators. Whenever Air Force revisions are made or addenda added to the FSP, a document control system shall be put into place to assure (1) all parties holding a controlled copy of the FSP shall receive the revisions/addenda and (2) outdated material is removed from circulation. The document control system does not preclude making and using copies of the FSP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations. The distribution list for controlled copies shall be maintained by the prime contractor.

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2.0 PROJECT BACKGROUND

2.1 THE U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM

The objective of the U.S. Air Force Installation Restoration Project (IRP) is to assess past hazardous waste disposal and spill sites at U.S. Air Force installations and to develop remedial actions consistent with the NCP for sites that pose a threat to human health and welfare or the environment. This section presents information on the program origins, objectives, and organization.

The 1976 Resource Conservation Recovery Act (RCRA) is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require federal agencies to comply with local and state environmental regulations and provide information to the EPA concerning past disposal practices at federal sites. RCRA Section 3012 requires state agencies to inventory past hazardous waste disposal sites and provide information to the EPA concerning those sites.

In 1980, Congress enacted CERCLA (Superfund). CERCLA outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. The CERCLA legislation identifies the EPA as the primary policy and enforcement agency regarding contaminated sites.

The 1986 Superfund Amendments and Reauthorization Act (SARA) extends the requirements of CERCLA and modifies CERCLA with respect to goals for remediation and the steps that lead to the selection of a remedial process. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends the EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and the consideration of potential remediation alternatives is recommended at the initiation of an RI/FS. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DOD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when they are the sole or co-contributor to contamination on or off their properties.

To ensure compliance with CERCLA, its regulations, and Executive Order 12580, the DOD developed the IRP, under the Defense Environmental Restoration Program, to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated facilities. The DOD issued the Defense

Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP program in June 1980, and implemented the policies outlined in this memorandum in December 1980. The NCP was issued by EPA in 1980 to provide guidance on a process by which (1) contaminant release could be reported, (2) contamination could be identified and quantified, and (3) remedial actions could be selected. The NCP describes the responsibility of federal and state governments and those responsible for contaminant releases.

The DOD formally revised and expanded the existing IRP directives and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated 11 December 1981. The memorandum was implemented by a U.S. Air Force message dated 21 January 1982.

The IRP is the DOD's primary mechanism for response actions on U.S. Air Force installations affected by the provisions of SARA. In November 1986, in response to SARA and other EPA interim guidance, the U.S. Air Force modified the IRP to provide for an RI/FS program. The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than serial activities. The program now includes ARAR determinations, identification and screening of technologies, and development of alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DOD compliance with federal laws, such as RCRA, NCP, CERCLA, and SARA, can be met.

2.2 PROJECT PURPOSE AND SCOPE

This project includes three primary tasks: a Preliminary Assessment (PA) and RCRA Facility Assessment (RFI) for Parcel D (the former Base Hospital); a background study at the Weapons Storage Area (WSA); and a basewide background study.

The purpose of the PA/RFI for Parcel D is to identify any areas of concern that may need remediation before the property is transferred to the Bureau of Prisons. This determination will be accomplished in the PA by reviewing available literature and by interviewing individuals familiar with historical waste handling practices at the former hospital. The results of this literature search and interviews will be reviewed to identify any areas of concern that require further investigation through sampling and analysis conducted as the RFI. If no areas of concern are identified as a result of the PA, an RFI will not be required.

The primary purpose of the background study at the WSA is to identify background concentrations of radionuclides in groundwater. Radionuclides were identified in previous sampling efforts, and Jacobs will install and sample groundwater monitoring wells in upgradient locations. Surface and subsurface soil sampling will

also be conducted. All samples will be analyzed for radionuclides and total petroleum hydrocarbons, because those contaminants of concern were identified during previous investigations in the area.

The basewide background study will determine naturally occurring background concentrations of metals in surface and subsurface soils, surface waters and sediments, and Terrace Alluvium groundwater.

2.3 PROJECT SITE DESCRIPTION

Sites to be investigated during this project include Parcel D, the WSA, and NAS Fort Worth. Information on these sites may be found in Section 2.1 of the Work Plan (Jacobs 1996), which is a companion document to this FSP.

2.4 PROJECT SITE CONTAMINATION HISTORY

Information on previous investigation and site contamination history may be found in Section 1.2 of the Work Plan (Jacobs 1996).

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3.0 PROJECT SCOPE AND OBJECTIVES

3.1 OBJECTIVES

The data quality objectives of the NAS Fort Worth and WSA field investigations are determined by the overall and specific objectives and purposes of the PA/RFI at Parcel D, Background Study at the WSA, and Basewide Background Study. The general purpose is to provide data to allow a decision of further action to be reached at each of the sites. The broad objectives of the IRP include the following:

- *Identify and evaluate sources where contamination may be present on DOD property because of past hazardous waste disposal practices, spills, leaks, or other occurrence.*
- *Control the migration of hazardous contaminants.*
- *Control the human health hazards or hazards to the environment that may result from past DOD disposal operations.*

Specific objectives of the investigations have been developed through discussions between the Air Force and Jacobs. These objectives have been refined during the planning process leading to this Work Plan and the companion SAP. The QAPP (Section 1.0 of the SAP) will be used to generate the data and to define the laboratory QA measures. Tables 3-1 and 3-2 describe the specific field activities to be completed, the number of samples to be collected, and the analyses to be performed at each site to accomplish the investigation objectives for each site.

3.1.1 Objectives of the Parcel D PA/RFI

The objectives of Parcel D PA/RFI are as follows:

- *Determine whether past hazardous waste disposal practices, spills, leaks, or other occurrence has resulted in contamination of surface soil, subsurface soil, or groundwater.*
- *Determine whether RFI is warranted.*
- *Determine whether any contamination levels exceeds ARARs or other criteria.*
- *Determine whether further action is warranted.*
- *Recommend further action as needed.*

3.1.2 Objectives of WSA Background Study

The objectives of the WSA background Study are as follows:

- *Establish background concentrations of radium-226 and -228 and TEPH in groundwater immediately upgradient of the WSA.*
- *Establish background concentrations of radium-226 and -228 and TEPH in surface and subsurface soils surrounding the WSA.*
- *Determine whether concentrations of radium previously detected in WSA well can be attributed to off-base human sources or to natural background sources.*

3.1.3 Objectives of Basewide Background Study

The objectives of the Basewide Background Study are as follows:

- *Obtain samples that are representative, to the degree possible, of background concentrations. This may be difficult in the highly urbanized setting of NAS Fort Worth, and because NAS Fort Worth is bounded on the west by Plant 4.*
- *Establish naturally occurring background levels of metals in groundwater, surface water, sediment, and soil.*

3.1.4 Data Types

Definitive data will be collected to accomplish the above-stated objectives for each site. No screening level chemical data will be collected. Data collected will include both physical parameters and chemical constituents, as well as spatial measurements of sampling locations.

Chemical constituents analyzed will vary depending on the medium being sampled and the objectives of the analyses. The samples collected will be transported to an offsite, fixed laboratory for analyses. Specific compounds and analytical methods are discussed in the QAPP (Section 1.0 of the SAP). The laboratory analyses will be the principal source of information regarding the nature and extent of contamination at source areas.

Additional data that will be collected include the locations of the sampling points. Both geographic position and elevation of sampling points will be recorded. Physical data such as water levels in monitoring wells; and lithologies of surface soil,

subsurface soil, rock and sediment, will be collected. Other physical measurements will be made of various parameters in surface water and groundwater samples, including pH, specific conductance, temperature, and turbidity.

3.2 SAMPLE ANALYSIS SUMMARY

The field investigations at Parcel D, the WSA, and at NAS Fort Worth will include sampling of surface soil, subsurface soil, sediment, surface water, and groundwater. The specific numbers of samples of each medium, by site, including environmental samples and Quality Control (QC) samples, are summarized in Table 3-1.

3.3 FIELD ACTIVITIES

Table 3-2 summarizes the field activities, by site, planned for completion during the investigations. Exact sampling locations have not been finalized. Exact locations for the Parcel D RFI, if necessary, will be chosen following the PA and site visit. The exact locations of surface and subsurface soil samples, and new monitoring wells at the WSA will be chosen during the presampling site visit or in the field. Existing wells to be sampled as part of the basewide background study, as well as the sediment and surface water sample locations along Farmers Branch have also not been finalized, and will be chosen during the presampling site visit or in the field.

Table 3-1
Sample Analysis Summary

Site	Method	Matrix	# Samples	# Equipment Blanks	# Ambient Blanks	# Trip Blanks	# Field Duplicates	Total # Samples
Parcel D	*Full Suite	SO/SS	12	2	1	3	1	19
Parcel D	*Full Suite	WG	6	2	1	2	1	12
WSA	Radium-226/228 (SW9315/SW9320)	SO/SS	30	5	0	0	3	38
WSA	TPH (E418.1)	SO/SS	30	5	0	0	3	38
WSA	Radium-226/228 (SW9315/SW9320)	WG	17	3	0	0	2	5
WSA	TPH (E418.1)	WG	17	3	0	0	2	5
Basewide	VOCs (SW8240), SVOCs (SW8270), Metals (SW6010 and 7000 series)	SO/SS/SE	68	11	1	11	7	97
Basewide	VOCs (SW8240), SVOCs (SW8270), Metals (SW6010 and 7000 series)	WS/WG	20	4	1	4	2	30
TOTALS			86	15	2	15	9	127

Notes:

SE = Sediment

SO = Soil

SS = Surface Soil

SVOC = Semivolatile Organic Compound

TPH = Total Petroleum Hydrocarbons

VOC = Volatile Organic Compound

WG = Groundwater

WS = Surface Water

WSA = Weapons Storage Area

All solids matrix data will be reported in dry weight (Method D2216).

Full Suite:

Parameter	Analytical Method
Semivolatile Organic Compounds (SVOCs)	SW8270
Volatile Organic Compounds (VOCs)	SW8240
Organochlorine Pesticides/PCBs	SW8080
Organophosphorous Compounds	SW8140
Chlorinated Herbicides	SW8150
Metals by ICP	SW6010
Arsenic (As)	SW7060
Antimony (Sb)	SW7041
Lead (Pb)	SW7421
Mercury (Hg)	SW7470
Nickel (Ni)	SW7520
Silver (Ag)	SW7760
Cadmium (Cd)	SW7130
Selenium (Se)	SW7740

Note: Compounds included in each analytical method are listed in tables in Section 7.0 of the Quality Assurance Project Plan.

**Table 3-2
Field Activities Summary**

Site	Activity	#
Parcel D	Site Visit	1
Parcel D	Surface Soil Sampling	6
Parcel D	Subsurface Soil Sampling	6
Parcel D	Groundwater Sampling	6
WSA	Soil Borings	5
WSA	Deep Well Drilling	2
WSA	Monitoring Well Installation (shallow)	3
WSA	Monitoring Well Installation (deep)	2
WSA	Well Development	5
WSA	Surface Soil Samples (buffer zone)	10
WSA	Subsurface Soil Samples (buffer zone = 10, soil borings = 10)	20
WSA	Groundwater Samples (deep wells x 4 = 12, existing wells = 2, new shallow wells = 3)	17 ^a
Basewide	Soil Borings	30
Basewide	Monitoring Well Installation	3
Basewide	Well Development	3
Basewide	Surface Soil Sampling	30
Basewide	Subsurface Soil Sampling	30
Basewide	Sediment Sampling (along Farmers Branch)	8
Basewide	Surface Water Sampling (along Farmers Branch)	8
Basewide	Groundwater Sampling (9 existing and 3 new wells)	12 ^b

Notes:

a - one private, offsite water supply well (Paluxy) will be sampled four times, along with the two new deep wells, for a total of 12 samples.

b - In addition to these 12 samples, results from the October sampling round will also be used for the background study.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The organization for the Jacobs project team includes technical professionals with experience in project management, QA, analytical chemistry, geology, environmental engineering, field investigations, data management, and other technical skills. Figure 4-1 is an organization chart that shows all key project personnel. Responsibilities for each of the project team positions are described below.

Contracting Officer's Representative and Point of Contact: *The AFCEE COR for Delivery Order No. 21 is Mr. Charles Rice, who is located at Brooks Air Force Base, Texas. The AFBCA Point of Contact (POC) for this project is Mr. Olen Long, who is located at NAS Fort Worth, Texas. The Jacobs project team will coordinate all activities conducted under this delivery order with these Air Force representatives through the Jacobs Project Manager, Ms. Lynn Schuetter, located at the Jacobs office in Denver, Colorado.*

Jacobs Program Manager: *The Jacobs Program Manager, Mr. Warner Reeser, will ensure high-quality work, make resources available, and approve all work under this delivery order. In addition, the Program Manager will review progress, anticipate and resolve problems, and ensure client satisfaction.*

Jacobs Project Manager: *As the Jacobs Project Manager, Ms. Schuetter has day-to-day responsibility for all aspects of work on Delivery Order No. 21. The Project Manager maintains close communication and coordinates all activities with the AFCEE COR and the POC for NAS Fort Worth. She is responsible for identifying appropriate staff for each task and providing oversight of all work to ensure its successful completion.*

Jacobs Quality Assurance Director: *The Jacobs QA Director, Mr. Kris Barrett, will ensure that all work is performed according to the specifications of the project plans. Mr. Barrett will report to the Air Force and be responsible for all program QA issues. In addition, Mr. Barrett will review evaluation reports, audits, and corrective action procedures to ensure that the project meets IRP Handbook standards.*

Jacobs Health and Safety Manager: *The Health and Safety Manager, Dr. Terry Briggs, will make certain that all work is performed in accordance with the approved Health and Safety Plan (HSP) and the provisions of the Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.20 for worker health and safety. Dr. Briggs will provide assistance, oversight, and senior review of the HSP. The Health and Safety Manager or his designee will perform audits to make certain that fieldwork is conducted to the specifications of the HSP.*

Jacobs Project Geologist: The Jacobs Project Geologist, Mr. Michael Johnson, will have responsibility for all field activities conducted for this delivery order. Mr. Johnson, or his designee, will participate in, and oversee, all soil sampling, monitoring well installation, and groundwater sampling. As a registered geologist, Mr. Johnson will also be responsible for reviewing and approving all boring logs and well completion logs prepared as part of this project.

Jacobs Project Chemist: Mr. Alan Alai will serve as Jacobs' Project Chemist for this project. His responsibilities will include preparation of laboratory bid packages, review of laboratory bids, evaluation of laboratory QAPPs, preparation of laboratory data packages for submittal to AFCEE, and overall quality review of laboratory data.

The regulatory agencies, Texas Natural Resource Conservation Commission (TNRCC) and U.S. Environmental Protection Agency, Region VI, serve in an oversight and review capacity. NAS Fort Worth is a TNRCC-lead site, and, therefore, TNRCC has final approval of all plans and reports related to this delivery order.

4.1 SUBCONTRACTORS

Subcontractors have not yet been selected for this project. As soon as subcontractors are selected, information will be provided to AFCEE.

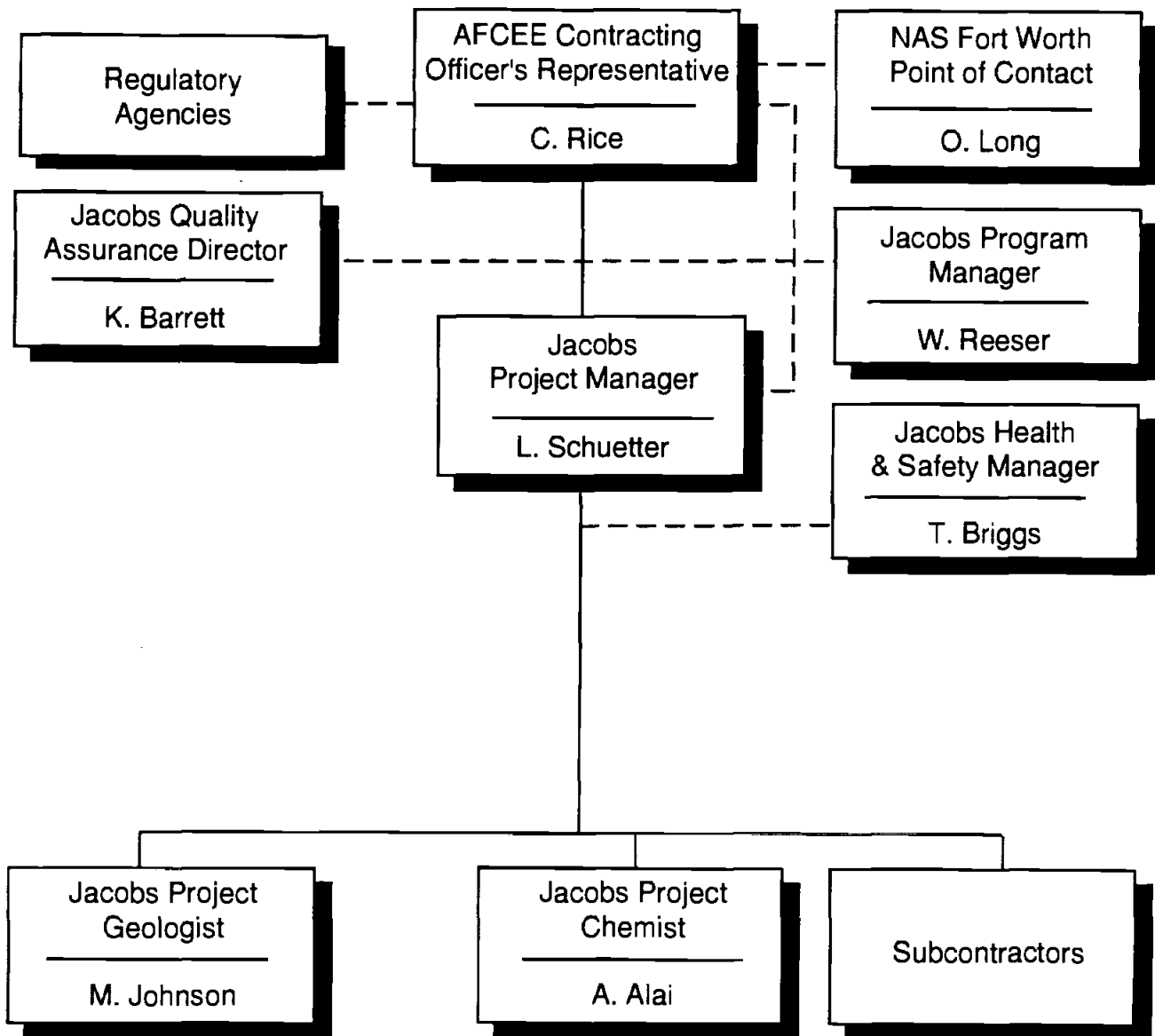


FIGURE 4-1
Project Organization Chart
PAIRFI for Parcel D and Background Studies at the WSA and NAS Fort Worth
NAS Fort Worth, Texas

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5.0 FIELD OPERATIONS

The following sections describe the procedures to be used during field operations. Included are sections describing standards for lithologic descriptions, site reconnaissance and restoration, borehole drilling, monitor well construction and development, surveying, equipment decontamination, and waste handling.

5.1 GEOLOGIC STANDARDS

The lithologic descriptions for consolidated materials (igneous, metamorphic, and sedimentary rocks) shall follow the standard professional nomenclature (cf. Tonnissen, A.C., 1983, *Nature of Earth Materials*, 2nd Edition, p. 204-348), with special attention given to describing fractures, vugs, solution cavities and their fillings or coatings, and any other characteristics affecting permeability. Colors shall be designated by the Munsell Color System.

The lithologic descriptions for unconsolidated materials (soils [engineering usage] or deposits) shall use the name of the predominant particle size (e.g., silt, fine sand, etc.). The dimensions of the predominant and secondary sizes shall be recorded using the metric system. The grain size and name of the deposit shall be accompanied by the predominant mineral content, accessory minerals, color, particle angularity, and any other characteristics. The clastic deposit descriptions shall include, as a supplement, symbols of the Unified Soil Classification System. The color descriptions shall be designated by the Munsell Color System.

The sedimentary, igneous, and metamorphic rocks and deposits shall be represented graphically by the patterns shown in Figure 5-1. Columnar sections, well and boring logs, well construction diagrams, cross sections, and three-dimensional (3-D) diagrams shall use these patterns. Supplementary patterns shall follow Swanson, R. G., 1981, *Sample Examination Manual*, American Association of Petroleum Geologists, p IV-41 and 43. Geologic structure symbols shall follow *American Geological Institute Data Sheets*, 3d Edition, 1989, sheets 3.1 through 3.8.

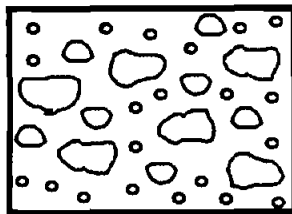
The scales for maps, cross sections, or 3-D diagrams shall be selected in accordance with the geologic and hydrologic complexity of the area and the purposes of the illustrations. Geophysical logs shall be run at a constant vertical scale of 1 inch equals 20 feet. When geophysical logs are superimposed on geologic logs, cross sections, or 3-D diagrams, the scales shall be the same. If defining geological conditions requires other scales, additional logs at those scales shall be provided.

For orientation, the cross sections shall show the Northern end on the viewer's right. If the line of cross section is predominantly East-West, the Eastern end is on the right.

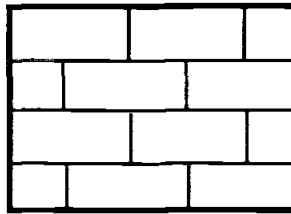
Figure 5-1

Lithologic Patterns for Illustration

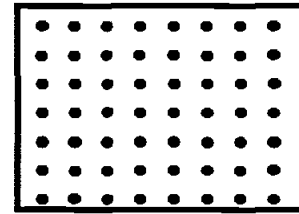
Sediments and Sedimentary Rocks



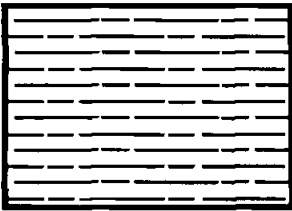
Gravel and Conglomerate



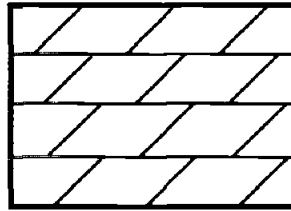
Limestone



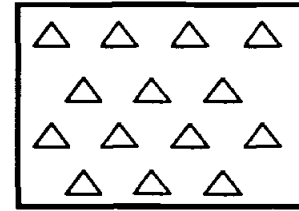
Sand and Sandstone



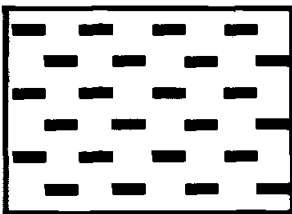
Silt and Siltstone



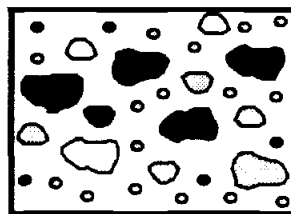
Dolomite



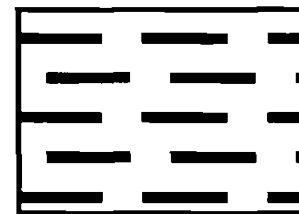
Chert



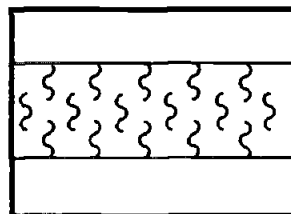
Clay



Glacial Till



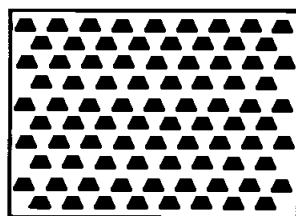
Shale



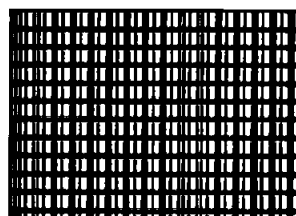
Loess

Figure 5-1
Lithologic Patterns for Illustration

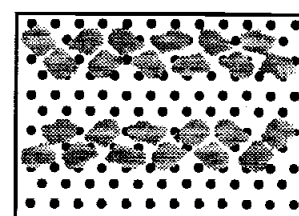
Igneous Rocks



Undifferentiated
Intrusive

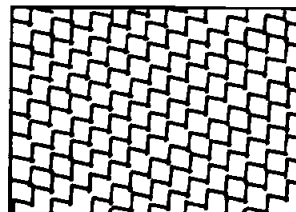


Basalt



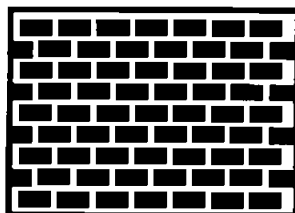
Volcanic Breccia
and Tuff

Metamorphic Rocks

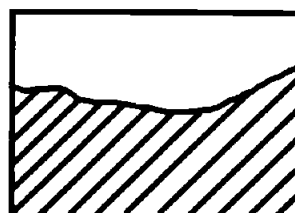


Undifferentiated

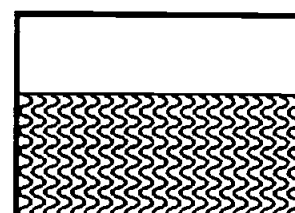
Miscellaneous



Fill



Undifferentiated
Bedrock



Residium

Maps shall be oriented with North toward the top, unless the shape of the area dictates otherwise. Indicate orientation with a North arrow.

5.2 SITE RECONNAISSANCE, PREPARATION, AND RESTORATION PROCEDURES

Areas designated for intrusive sampling shall be surveyed for the presence of underground utilities. Utility locations are determined using existing utility maps, and in the field, are verified using a hand-held magnetometer or utility probe. Vehicle access routes to sampling locations shall be determined prior to any field activity.

A centralized decontamination area shall be provided for drilling rigs and equipment.

The decontamination area shall be large enough to allow storage of cleaned equipment and materials prior to use, as well as to stage drums of decontamination waste. The decontamination area shall be lined with a heavy gauge plastic sheeting, and designed with a collection system to capture decontamination waters. Solid wastes shall be accumulated in 55-gallon drums and subsequently transported to a waste storage area designated by the Air Force. Smaller decontamination areas for personnel and portable equipment shall be provided as necessary. These locations shall include basins or tubs to capture decontamination fluids, which shall be transferred to a large accumulation tank as necessary. *Decontamination area locations will be established at the WSA and at NAS Fort Worth during the presampling site visit.*

Jacobs maintains a field office at NAS Fort Worth, which is located at 6560 White Settlement Road.

Each work site or sampling location shall be returned to its original condition when possible. Efforts shall be made to minimize impacts to work sites and sampling locations, particularly those in or near sensitive environments such as wetlands. Following the completion of work at a site, all drums, trash, and other waste shall be removed. Decontamination and/or purge water and soil cuttings shall be transported to the designated locations as described in Section 5.12.

5.3 GEOPHYSICAL SURVEYS

Not applicable.

5.4 SOIL GAS SURVEYS

Not applicable.

5.5 BOREHOLE DRILLING, LITHOLOGIC SAMPLING, LOGGING, AND ABANDONMENT

The following sections describe the procedures for borehole drilling, logging, and borehole abandonment.

5.5.1 General Drilling Procedures

Shallow monitoring wells, and soil borings beyond the capabilities of direct-push technology will be completed using a hollow-stem auger (HSA) drill rig, while the deep monitoring wells at the WSA will be drilled using either an air or mud rotary rig. The exact type of rigs used will be decided after the subcontractors have been chosen.

All drilling activities shall conform with state and local regulations and shall be supervised by a state licensed geologist or state licensed engineer. The contractor shall obtain and pay for all permits, applications, and other documents required by state and local authorities.

The location of all borings shall be coordinated, in writing, with the base civil engineer or equivalent before drilling commences. When drilling boreholes through more than one water bearing zone or aquifer, the contractor shall take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

The drill rig shall be cleaned and decontaminated IAW the procedure in Section 5.12. The drill rig shall not leak any fluids that may enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable.

Drilling fluids shall consist of air, water, or mud. If air is used, it shall be filtered to remove organic vapors, and filters shall be changed daily. The effectiveness of the air filter shall be checked at least every 4 hours using a photoionization detector (PID) or flame ionization detector (FID). If organic vapors are detected in air passing through the downstream end of the air line or drill stem, their source (i.e., filter, contaminated line, etc.) shall be decontaminated or replaced. If water is used, the contractor shall provide chemical analyses of the water for AFCEE approval. Only water from a pre-approved source shall be used as a drilling fluid and the water quality shall be monitored daily for suspected analytes of concern. Drilling mud, if used, shall consist of 100 percent sodium bentonite and shall be approved by the AFCEE. The prime contractor shall provide AFCEE with the chemical analyses of any drilling mud additive or substitute proposed for use prior to the start of drilling. The additives or substitutes shall be analyzed for all analytes of concern at the site. The analyses shall be delivered to the AFCEE for written approval prior to drilling system mobilization. Mud or other additives shall only be used as a last resort.

Lubricants shall not introduce or mask contaminants. The contractor shall provide chemical analyses of all lubricants proposed for downhole use. Chemical detection limits shall be equivalent to those used in analyzing project groundwater samples. Lubricants with constituents that are toxic or that increase, decrease, or mask the target chemical species of the investigation shall not be permitted. The contractor shall provide the analysis results to the AFCEE prior to drilling mobilization.

A log of drilling activities shall be kept in a bound field notebook. Information in the log book shall include location, time on site, personnel and equipment present, down time, materials used, samples collected, measurements taken, and any other observations or information that would be necessary to reconstruct field activities at a later date. At the end of each day of drilling the drilling supervisor shall complete a Daily Drilling Log. An example of the Daily Drilling Log is shown in Section 8.0. All items on the log must be completed, if known.

The contractor shall dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or representative.

5.5.2 Logging

The lithology in all boreholes shall be logged. The boring log form, in Section 8.0, shall be used for recording the lithologic logging information. Information on the boring log sheet includes the borehole location; drilling information; sampling information such as sample intervals, recovery, and blow counts; and sample description information.

Unconsolidated samples for lithologic description shall be obtained at each change in lithology or every five (5) foot interval, whichever is less or as specifically stated in the SOW. Lithologic descriptions of unconsolidated materials encountered in the boreholes shall generally be described in accordance with American Society for Testing and Materials (ASTM) D-2488-90 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM, 1990). Descriptive information to be recorded in the field shall include: (1) identification of the predominant particles size and range of particle sizes, (2) percent of gravel, sand, fines, or all three, (3) description of grading and sorting of coarse particles, (4) particle angularity and shape, and (5) maximum particle size or dimension.

Plasticity of fines description include: (1) color using Munsell Color System, (2) moisture (dry, wet, or moist), (3) consistency of fine grained soils, (4) structure of consolidated materials, and (4) cementation (weak, moderate, or strong).

Identification of the Unified Soil Classification System (USCS) group symbol shall be used. Additional information to be recorded includes the depth to the water table, caving or sloughing of the borehole, changes in drilling rate, depths of laboratory

samples, presence of organic materials, presence of fractures or voids in consolidated materials, and other noteworthy observations or conditions, such as the locations of geologic boundaries.

Lithologic descriptions of consolidated materials encountered in the boreholes shall generally be described in accordance with Section 5.1. Consolidated samples for lithologic description shall be obtained at each change in lithology or at five-foot intervals, whichever is less, or as specified in the SOW. All samples shall be monitored with an organic vapor monitor (e.g., PID, organic vapor analyzer [OVA]). The samples shall be handled in such a way as to minimize the loss of volatiles, and these procedures shall be described in Section 6.0. Cuttings shall be examined for their hazardous characteristics. Materials that are suspected to be hazardous because of abnormal color, odor, or organic vapor monitor readings shall be containerized in conformance with the Resource Conservation and Recovery Act (RCRA) and the state and local requirements. *One of the deep monitoring wells at the WSA will be cored from the surface to total depth.* Rock cores shall be stored in standard core boxes, and missing sections of core shall be replaced with spacers.

Lithologic descriptions of consolidated materials shall follow the specifications in Section 5.1.

5.5.3 Abandonment

Boreholes that are not converted to monitor wells shall be abandoned in accordance with applicable federal, state or local requirements. If a slurry is used, a mud balance and/or Marsh Funnel shall be used to ensure the density (lbs/gal) of the abandonment mud mixture conforms with the manufacturer's specifications. The slurry shall be emplaced from the bottom to the top of the hole using a tremie pipe.

All abandoned boreholes shall be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications may be recommended by the manufacturer and shall be followed. If settling has occurred, a sufficient amount of mud/solid bentonite shall be added to fill the hole to the ground surface. These curing checks and any addition of mud/solid bentonite shall be recorded in the field log.

5.6 MONITOR WELL CONSTRUCTION

The on-site field manager shall supervise the drilling, soil boring, geophysical surveys, lithologic sampling, and monitor well construction and shall be a state-licensed geologist, hydrogeologist, or geotechnical engineer, or shall be certified by the American Institute of Hydrology, American Institute of Professional Geologists, or the National Ground Water Association as a Certified Ground Water Professional. The supervising field manager shall affix his/her signature and registration/ certification seal

to all drilling logs, as-built well construction diagrams, lithologic logs, sampling records, and similar documents. When there is a possibility that floating petroleum products shall be encountered, shallow monitor wells shall be screened across the water table. The length of the screen shall be such that tidal and seasonal water table fluctuations shall not cause water levels to rise above or fall below the screened interval.

5.6.1 Drilling Requirements

All drilling and well installations shall conform to state and local regulations, and the contractor shall obtain and pay for all permits, applications, and other documents required by state and local authorities. The location of all borings shall be coordinated in writing with the base civil engineer or equivalent before drilling commences.

The rig shall be cleaned and decontaminated according to the guidelines described in Section 5.12. The rig shall not leak any fluids that may enter the borehole or contaminate equipment that is placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable. The only acceptable drilling fluids are air, water, and mud. The air used shall be filtered to remove organic vapors, and if water is used, the prime contractor shall provide chemical analyses of the water showing the purity. The water quality shall be monitored daily for suspected analytes of concern. The mud used shall be 100 percent sodium bentonite and the contractor shall provide chemical analyses of any drilling mud additive or substitute (e.g., foam, biodegradable material, etc.) proposed for use. The additives or substitutes for drilling shall be analyzed for all analytes of concern at the site and they shall be approved prior to drilling mobilization.

When air is used, the effectiveness of the air filter shall be checked at least every four hours. The air passing through the downstream end of the air line shall be monitored with an organic vapor monitor (e.g., PID, OVA), and if organic vapors are detected, their source (filter, contaminated line, etc.) shall be decontaminated or replaced.

Drilling lubricants shall not introduce or mask contaminants at the site. The contractor shall provide, to AFCEE, chemical analyses of all lubricants proposed for downhole use prior to the start of drilling. Chemical detection limits shall be equivalent to those used in analyzing the project groundwater samples. Lubricants with constituents that are toxic or that increase, decrease, or mask the target chemical species of the investigation shall not be permitted. The contractor shall provide the analysis results prior to drilling mobilization.

The contractor shall dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or representative. When installing wells through more than one water-bearing zone or aquifer, the contractor shall take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

5.6.2 Borehole Requirements

Borehole diameters shall be at least four inches larger than the outside diameter of the casing and well screen. In the case of a hollow stem auger, the inside diameter of the auger shall be at least four inches larger than the outside diameter of the casing and well screen.

A completed monitor well shall be straight and plumb. The monitor well shall be sufficiently straight to allow passage of pumps or sampling devices. The monitor well shall be plumb within 1 degree of vertical where the water level is greater than 30 feet below land surface unless otherwise approved by AFCEE. AFCEE may waive a plumbness requirement. Any request for a waiver from straightness or plumbness specifications shall be made, in writing, to AFCEE in advance of mobilization for drilling. The contractor shall use a single-shot declination tool to demonstrate plumbness. Monitor wells not meeting straightness or plumbness specifications shall be redrilled and/or reconstructed.

Formation samples for lithologic description shall be obtained at each change in lithology or at five-foot intervals, whichever is less, or as specified in the SOW. All samples shall be monitored with an organic vapor monitor (e.g., PID, OVA). The samples shall be handled in such a way as to minimize the loss of volatiles, and these procedures shall be described in Section 6.0. Cuttings shall be examined for their hazardous characteristics. Materials that are suspected to be hazardous because of abnormal color, odor, or organic vapor monitor readings shall be containerized in conformance with (RCRA) and the state and local requirements. Rock cores shall be stored in standard core boxes, and missing sections of core shall be replaced with spacers.

The documentation record and forms, Section 8.0, shall document the following information for each boring: (1) boring or well identification (this identification shall be unique, and the contractor is responsible for ensuring that it has not been used previously at the installation), (2) purpose of the boring (e.g., soil sampling, monitor well), (3) location in relation to an easily identifiable landmark, (4) names of drilling contractor and logger, (5) start and finish dates and times, (6) drilling method, (7) types of drilling fluids and depths at which they were used, (8) diameters of surface casing, casing type, and methods of installation, (9) depth at which saturated conditions were first encountered, (10) lithologic descriptions and depths of lithologic boundaries, (11) sampling-interval depths, (12) zones of caving or heaving, (13) depth at which drilling fluid was lost and the amount lost, (14) changes in drilling fluid properties, (15) drilling rate, and (16) drilling rig reactions, such as chatter, rod drops, and bouncing.

In addition to the above, the following information shall be recorded when rock core samples are collected: (1) the depth interval and top and bottom of each core shall be marked on the core box, (2) percentage of core recovered, (3) number of fractures per foot, (4) angle of fractures relative to the core axis, and (5) breaks due to coring and core handling shall be distinguished from naturally occurring fractures.

A standard penetration test shall be performed each time a split spoon sample is taken. The test shall be performed in accordance with ASTM D-1586.

5.6.3 Casing Requirements

Shallow wells will be constructed of 2-inch Schedule 40 polyvinyl chloride (PVC) casing. The deep wells drilled at the WSA will be constructed of 4-inch, Schedule 40 PVC casing. The casing requirements that shall be followed are: (1) all casing shall be new, unused, and decontaminated according to the specifications of Section 5.12, (2) glue shall not be used to join casing, and casings shall be joined only with compatible welds or couplings that shall not interfere with the planned use of the well, (3) all polyvinyl chloride shall conform to the ASTM Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System), (4) all metal casing shall be seamless stainless steel casing, and the casing "mill" papers shall be included in the appendix of the technical report, (5) the casing shall be straight and plumb within the tolerance stated for the borehole, and (6) the driller shall cut a notch in the top of the casing to be used as a measuring point for water levels.

5.6.4 Well Screen Requirements

Shallow wells will be constructed of 2-inch Schedule 40 PVC screen with 0.020-inch slot size or as compatible with formation materials. The deep wells drilled at the WSA will be constructed of 4-inch Schedule 40 PVC casing. Well screen requirements are: (1) all requirements that apply to casing shall also apply to well screen, except for strength requirements, (2) monitor wells shall not be screened across more than one water-bearing unit, (3) screens shall be factory slotted or wrapped, (4) screen slots shall be sized to prevent 90 percent of the filter pack from entering the well, and for wells where no filter pack is used, the screen slot size shall be selected to retain 60 to 70 percent of the formation materials opposite the screen, and (5) the bottom of the screen is to be capped, and the cap shall be joined to the screen by threads.

The contractor may propose open-hole wells in bedrock where cave-in is unlikely. Prior approval for such wells shall be obtained, in writing, from AFCEE.

5.6.5 Annular Space Requirements

The annular space requirements are the following: (1) the annular space shall be filled with a filter pack, a bentonite seal, and casing grout between the well string and the

borehole wall, (2) any drilling fluids shall be thinned with potable water of known acceptable quality to a density less than 1.2 g/cm³ (10 lb/gal) before the annular space is filled, and a mud balance or Marsh Funnel shall be kept on site to allow measurement of drilling fluid density, and (3) as the annular space is being filled, the well string shall be centered and suspended such that it does not rest on the bottom of the hole, and for wells greater than 50 feet deep, at least two centralizers shall be used, one at the bottom and one at the top of the screen. Additional centralizers shall be used as needed.

5.6.6 Filter Pack Requirements

The filter pack shall consist of silica sand or gravel and shall extend from the bottom of the hole to at least two feet above the top of the well screen. After the filter pack is emplaced, the well shall be surged with a surge block for ten minutes. The top of the sand pack shall be sounded to verify its depth during placement. Additional filter pack shall be placed as required to return the level of the pack to two feet above the screen. Surge the well for five minutes. Again, place additional filter pack as required to bring its level to two feet above the screen. If gravel is used, six inches of coarse sand shall be placed on top of the gravel.

The filter pack material shall be clean, inert, and well-rounded and shall contain less than two percent flat particles. The sand or gravel shall be certified free of contaminants by vendor or contractor. If decontamination is necessary, the methods shall be approved in writing by AFCEE.

The filter pack shall have a grain size distribution and uniformity coefficient compatible with the formation materials and the screen, as described in Chapter 12, *Ground Water and Wells*, 2nd Edition, 1986. The filter pack shall not extend across more than one water-bearing unit. In all wells (deep or shallow), the filter pack shall be emplaced with a bottom-discharge tremie pipe of at least 1-1/2 inches in diameter. The tremie pipe shall be lifted from the bottom of the hole at the same rate the filter pack is set. The contractor shall record the volume of the filter pack emplaced in the well. Potable water may be used to emplace the filter pack so long as no contaminants are introduced. The contractor may use formation materials as a filter pack when they are compatible with the slot size of the screen, such as in glacial outwash gravel deposits.

Because wells have been constructed extensively in the Paluxy sand and the Terrace Alluvium, the drillers' previous experience with filter pack material will be used to select the appropriate material when possible.

5.6.7 Bentonite Seal Requirements

The bentonite seal requirements that shall be followed are the following: (1) the bentonite seal shall consist of at least two feet of bentonite between the filter pack and

the casing grout, (2) the bentonite shall be hydrated before placement and shall be installed by pump tremie methods, and (3) only 100 percent sodium bentonite shall be used.

For wells less than fifteen feet, the contractor may propose alternate sealing methods. Prior approval for any alternate method shall be obtained, in writing, from AFCEE before well construction begins.

5.6.8 Casing Grout Requirements

The casing grout requirements are the following: (1) the casing grout shall extend from the top of the bentonite seal to ground surface, (2) the grout shall be mixed in the following proportions: 94 pounds of neat Type I Portland or American Petroleum Institute Class A cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water, (3) all grout shall be pump tremied using a side-discharge tremie pipe, and pumping shall continue until 20 percent of the grout has been returned to the surface, and (4) in wells where the bentonite seal is visible and within 30 feet of the land surface, the 20 percent return is not necessary so long as the tremie pipe is pulled back as the grout is emplaced.

5.6.9 Surface Completion Requirements

It is estimated that surface casing will be necessary for the deep wells to a depth of approximately 35 feet below ground surface. For flush-mounted completions, cut the casing about three inches below the land surface and provide a water-tight casing cap to prevent surface water from entering the well. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole shall be placed in the upper portion of the casing, or a ventilated well cap shall be used. A freely draining valve box with a locking cover shall be placed over the casing. The top of the casing shall be at least one foot above the bottom of the box. The valve box lid shall be centered in a three-foot diameter, four-inch thick concrete pad that slopes away from the box at 1/4 inch per foot. The identity of the well shall be permanently marked on the valve box lid and the casing cap. Where heavy traffic may pass over the well or for other reasons, the concrete pad and valve box/lid assembly shall be constructed to meet the strength requirements of surrounding surfaces.

When above-ground surface completion is used, extend the well casing two or three feet above land surface. Provide a casing cap for each well, and shield the extended casing with a steel sleeve that is placed over the casing and cap and seated in a 3-foot by 3-foot by 4-inch concrete surface pad. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole shall be placed in the well casing, or a ventilated well cap shall be used. The concrete surface pad shall be reinforced with steel reinforcing bars at least 1/4 inch in diameter. The ground surface shall be freed of grass and scoured to a depth of two inches before setting the concrete pad. The diameter of the sleeve shall

be at least six inches greater than the diameter of the casing. Slope the pad away from the well sleeve. Install a lockable cap or lid on the guard pipe. The identity of the well shall be permanently marked on the casing cap and the protective sleeve. Install three 3-inch diameter concrete-filled steel guard posts. The guard posts shall be five feet in total length and installed radially from each well head. Recess the guard posts approximately two feet into the ground and set in concrete. Do not install the guard posts in the concrete pad placed at the well base. The protective sleeve and guard posts shall be painted with a color specified by the installation civil engineer. In areas of extreme frost heaving, the concrete pads specified may not be appropriate, and alternate designs may be required. Special consideration and approvals may be needed in these areas.

All wells shall be secured as soon as possible after drilling. Provide corrosion-resistant locks for both flush and above-ground surface completions. The locks must either have identical keys or be keyed for opening with one master key. Deliver the lock keys to the appropriate Air Force personnel following completion of the field effort.

5.6.10 Piezometer Requirements

Not applicable.

5.6.11 Well/Piezometer Completion Diagrams

A completion diagram shall be submitted for each monitor well or piezometer installed. It shall include the following information: (1) well identification (this shall be identical to the boring identification described), (2) drilling method, (3) installation date(s), (4) elevations of ground surface and the measuring point notch, (5) total boring depth, (6) lengths and descriptions of the screen and casing, (7) lengths and descriptions of the filter pack, bentonite seal, casing grout, and any back-filled material, (8) elevation of water surface before and immediately after development, and (9) summary of the material penetrated by the boring.

5.6.12 Suction Lysimeters

Not applicable.

5.7 MONITOR WELL DEVELOPMENT

The monitor well development requirements are: (1) all newly installed monitor wells shall be developed no sooner than 24 hours after installation to allow for grout curing, (2) all drilling fluids used during well construction shall be removed during development, (3) wells shall be developed using surge blocks and bailers or pumps (prior approval for any alternate method shall be obtained, in writing, from AFCEE before well construction begins), and wells shall be developed until: (a) the suspended

sediment content of the water is less than 0.75 mL/L, as measured in an Imhoff cone according to method E160.5; (b) the turbidity remains within a 10 nephelometric turbidity unit range for at least 30 minutes; and (c) the stabilization criteria in Section 6.1.1.1.3 are met, (4) discharge water color and volume shall be documented, (5) no sediment shall remain in the bottom of the well, (6) no detergents, soaps, acids, bleaches, or other additives shall be used to develop a well, and (7) all development equipment shall be decontaminated according to the specifications of Section 5.12.

Purge water from the two new deep wells and the private well will be allowed to run onto the ground surface. Purge and development water from the three shallow wells and the two WSA water supply wells will be containerized, sampled, and disposed of offsite, if necessary. If sample results indicate that no significant contamination is found, then the water will be released to the surface, as long as it does not leave the fenced WSA area as surface runoff.

5.8 ABANDONING MONITOR WELLS

Not applicable.

5.9 AQUIFER TESTS

Not applicable.

5.10 TEST PIT EXCAVATION

Not applicable.

5.11 SURVEYING

The bench mark(s) that will be used for surveying locations at NAS Fort Worth and the WSA will be determined during the presampling site visit.

All surveying locations of field activities shall be measured by a certified land surveyor as the distance in feet from a reference location that is tied to the state plane system. The surveys shall be third order (cf. Urquhart, L.C., 1962 *Civil Engineering Handbook*, 4th Edition, p. 96 and 97). An XY-coordinate system shall be used to identify locations. The X-coordinate shall be the East-West axis; the Y-coordinate shall be the North-South axis. The reference location is the origin. All surveyed locations shall be reported using the state plane coordinate system. The surveyed control information for all data collection points shall be recorded and displayed in a table. The table shall give the X and Y coordinates in state plane coordinate values, the ground elevation, and the measuring point elevation if the location is a groundwater monitor well. The elevation of all newly installed wells and piezometers

shall be surveyed at the water level measuring point (notch) on the riser pipe. Include the elevation of the ground surface in the survey.

5.12 EQUIPMENT DECONTAMINATION

All equipment that may directly or indirectly contact samples shall be decontaminated in a designated decontamination area. This includes casing, drill bits, auger flights, the portions of drill rigs that stand above boreholes, sampling devices, and instruments, such as slugs and sounders. In addition, the contractor shall take care to prevent the sample from coming into contact with potentially contaminating substances, such as tape, oil, engine exhaust, corroded surfaces, and dirt.

The following procedure shall be used to decontaminate large pieces of equipment, such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods. The external surfaces of equipment shall be washed with high-pressure hot water and Alconox, or equivalent laboratory-grade detergent, and if necessary, scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The equipment shall then be rinsed with potable water. The inside surfaces of casing, drill rod, and auger flights shall also be washed as described.

The following procedure shall be used to decontaminate sampling and drilling devices, such as split spoons, bailers, and augers, that can be hand-manipulated. For sampling and smaller drilling devices, scrub the equipment with a solution of potable water and Alconox, or equivalent laboratory-grade detergent. Then rinse the equipment with copious quantities of potable water followed by a ASTM Type II Reagent Water. High pressure liquid chromatograph-grade water and distilled water purchased in stores are not acceptable substitutes for ASTM Type II Reagent-Grade Water. Then rinse the equipment with pesticide-grade methanol followed by pesticide-grade hexane. Air dry the equipment on a clean surface or rack, such as Teflon, stainless steel, or oil-free aluminum elevated at least two feet above ground. If the sampling device shall not be used immediately after being decontaminated, it shall be wrapped in oil-free aluminum foil, or placed in a closed stainless steel, glass, or Teflon container.

Reagent-Grade II Water, methanol, and hexane shall be purchased, stored, and dispensed only in glass, stainless steel, or Teflon containers. These containers shall have Teflon caps or cap liners. It is the contractor's responsibility to assure these materials remain free of contaminants. If any question of purity exists, new materials shall be used.

5.13 WASTE HANDLING

Because they are background wells, purge and development water from the two new deep wells will be allowed to run onto the ground surface. Disposal of soil, cuttings, and drilling mud produced from the deep wells will be the responsibility of the drilling subcontractor.

Purge and development water from the three new shallow wells and the existing water supply wells at the WSA will be containerized, sampled, and disposed of offsite, if necessary. All containerized waste will be sampled for disposal in accordance with 30 Texas Administrative Code 335, Subchapter R. If sample results indicate that no significant contamination is found, then the water will be released to the surface, as long as it does not leave the fenced WSA area as surface runoff. Soil and cuttings produced from drilling the shallow wells on the WSA site will be containerized and disposed of offsite if analytical results require it.

Because they are background wells, soil and purge and development water from the two new monitoring wells at NAS Fort Worth will be disposed of on the ground surface. Purge water from sampling the existing wells at the base will be disposed of onsite. Jacobs will request permission from Aeronautical Systems Center (ASC) to use the IT Corporation treatment system. If this option is not available, Jacobs will treat the water using an activated carbon filter system.

5.13.1 General Waste Handling Procedures

Waste handling shall be dealt with on a site-by-site basis. Waste may be classified as noninvestigative waste or investigative waste.

Noninvestigative waste, such as litter and household garbage, shall be collected on an as-needed basis to maintain each site in a clean and orderly manner. This waste shall be containerized and transported to the designated sanitary landfill or collection bin. Acceptable containers shall be sealed boxes or plastic garbage bags.

Investigation derived waste shall be properly containerized and temporarily stored at each site, prior to transportation. Depending on the constituents of concern, fencing or other special marking may be required. The number of containers shall be estimated on an as-needed basis. Acceptable containers shall be sealed, U.S. Department of Transportation (DOT)-approved steel 55-gallon drums or small dumping bins with lids. The containers shall be transported in such a manner to prevent spillage or particulate loss to the atmosphere. To facilitate handling, the containers shall be no more than half full when moved.

The investigative derived waste shall be segregated at the site according to matrix (solid or liquid) and as to how it was derived (drill cuttings, drilling fluid,

decontamination fluids, and purged groundwater). Each container shall be properly labeled with site identification, sampling point, depth, matrix, constituents of concern, and other pertinent information for handling.

5.14 HYDROGEOLOGICAL CONCEPTUAL MODEL

Not applicable.

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6.0 ENVIRONMENTAL SAMPLING

6.1 SAMPLING PROCEDURES

All purging and sampling equipment shall be decontaminated according to the specifications in Section 5.12 prior to any sampling activities and shall be protected from contamination until ready for use.

6.1.1 Groundwater Sampling

6.1.1.1 Monitor Well Sampling

When numerous monitor wells are to be sampled in succession, those wells expected to have low levels of contamination or no contamination shall be sampled prior to those wells expected to have higher levels of contamination. This practice will help reduce the potential for cross contamination between wells. All sampling activities shall be recorded in the field log book. Additionally, all sampling data shall be recorded on a well sampling form. An example of a well sampling form is shown in Section 8.0.

Before groundwater sampling begins, wells shall be inspected for signs of tampering or other damage. If tampering is suspected, (i.e., casing is damaged, lock or cap is missing) this shall be recorded in the field log book and on the well sampling form, and reported to the Field Operations Leader. Wells that are suspected to have been tampered with shall not be sampled until the Field Operations Leader has discussed the matter with the project manager.

Before the start of sampling activities, plastic sheeting shall be placed on the ground surrounding the well. The plastic sheeting shall be used to provide a clean working area around the well head, and prevent any soil contaminants from contacting sampling equipment. Remove water in the protective casing or in the vaults around the well casing prior to venting and purging. Every time a casing cap is removed to measure water level or collect a sample, the air in the breathing zone shall be checked with an organic vapor meter and the air in the well bore shall be checked with an explosimeter. Procedures in the Health and Safety Plan (HSP) shall be followed when high concentrations of organic vapors or explosive gases are detected. Air monitoring data shall be recorded on the well sampling form.

Purge pump intakes shall be equipped with a positive foot check valve to prevent purged water from flowing back into the well. Purging and sampling shall be performed in a manner that minimizes aeration in the well bore and the agitation of sediments in the well and formation. Equipment shall not be allowed to free-fall into a well.

In addition to the information required in Section 8.0, the following information shall be recorded each time a well is purged and sampled. This information shall be encoded in IRP Information Management System (IRPIMS) files when required. (1) depth to water before and after purging, (2) well bore volume calculation, (3) sounded total depth of the monitor well, (4) the condition of each well, including visual (mirror) survey, (5) the thickness of any nonaqueous layer, (6) field parameters, such as pH, temperature, specific conductance, and turbidity.

6.1.1.1.1 Water Level Measurement

An interface probe shall be used if a nonconductive floating product layer is suspected in the well. The interface probe shall be used to determine the presence of floating product, if any, prior to measurement of the groundwater level. The groundwater level shall then be measured to the nearest 0.01 foot using an electric water level indicator. Water levels shall be measured from the notch located at the top of the well casing and recorded on the well sampling form. If well casings are not notched, measurements shall be taken from the north edge of the top of the well casing, and a notch shall be made using a decontaminated metal file.

Following water level measurement, the total depth of the well from the top of the casing shall be determined using a weighted tape or electric sounder and recorded on the well sampling form. The water level depth shall then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. All water level and total depth measuring devices shall be routinely checked with a tape measure to ensure measurements are accurate.

6.1.1.1.2 Purging Prior to Sampling

Purging of monitor wells is performed to evacuate water that has been stagnant in the well and may not be representative of the aquifer. Purging shall be accomplished using a Teflon bailer or a pump.

At least three well volumes shall be removed from the well before it is sampled. The well bore volume is defined as the volume of submerged casing and screen. One well volume can be calculated using the following equation (reference: Ohio EPA Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring Programs, June 1993):

$$V = H \times F$$

where V = one well volume

H = the difference between the depth of well and depth to water (ft)

F = factor for volume of one foot section of casing (gallons) from Table 6.1

Table 6.1 Volume of Water in One-Foot Section of Well Casing

Diameter of Casing (inches)	F Factor (gallons)
1.5	0.09
2	0.16
3	0.37
4	0.65
6	1.47

F can also be calculated from the formula:

$$F = \pi (D/2)^2 \times 7.48 \text{ gal/ft}^3$$

where D = the inside diameter of the well casing (feet).

Wells with yields too low to produce three well volumes before the well goes dry shall be purged to dryness.

The temperature, pH, electrical conductivity (EC), and turbidity shall be measured and recorded on the well sampling form after removing each well volume during purging. Water removed from the well during purging shall be containerized. Detailed information concerning investigative derived wastes is presented in Section 5.13.

6.1.1.1.3 Sample Collection

Samples shall not be taken within 24 hours of monitor well development. Except as noted below, at least three well volumes shall be removed from the well before it is sampled.

The sample may be collected after three well volumes have been removed and the temperature, pH, and EC have stabilized. Stabilization shall be defined as follows: temperature +/- 1°C, pH +/- 0.1 units, EC +/- 5 percent. If these parameters do not stabilize, the sample shall be collected after six well volumes have been removed, and the anomalous parameters shall be brought to the Field Operations Leader's attention. Field equipment shall be calibrated IAW the AFCEE QAPP, Section 5.0 and in Section 7.2 of this FSP.

Samples shall be collected after the water level has recovered to 80 percent of its static level or 16 hours after completion of purging, whichever occurs first. If a monitor well is bailed or pumped dry before three well volumes can be obtained, the sample shall be collected when a sufficient volume of water has accumulated in the well.

Before collecting groundwater samples, the sampler shall don clean, phthalate-free protective gloves. Samples to be analyzed for volatile organic compounds (VOCs) shall be collected first using a bottom-filling PVC bailer. Samples to be analyzed for volatile or gaseous constituents shall not be withdrawn with pumps that exert a vacuum on the sample (e.g., centrifugal). Disposable nylon rope shall be used to lower and retrieve the bailers. A new length of nylon rope shall be used for each well, and the rope shall be disposed of following the sampling activities. Each bailer shall be equipped with a dedicated stainless steel or Teflon coated leader so that the nylon rope shall not contact the water in the well.

If dense nonaqueous phase liquids (DNAPL) are suspected, a bailer shall be lowered to the bottom of the well before purging, retrieved, and observed for the presence of DNAPL. The preservative hydrochloric acid shall be added to the VOC sample bottle before introducing the sample water. The sample shall be collected from the bailer using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization. The sample vial shall be filled until a meniscus is visible and immediately sealed. When the bottle is capped, it shall be inverted and gently tapped to ensure no air bubbles are present in the vial. Vials with trapped air shall be refilled until no bubbles are present. After the containers are sealed, sample degassing may cause bubbles to form. These bubbles shall be left in the container. These samples shall never be composited, homogenized, or filtered.

Following collection of VOC samples, remaining water samples shall be collected in the following order: polynuclear aromatic hydrocarbons (PAHs); metals; mercury; cyanide; total organic carbon; anions/cations; dissolved oxygen.

The pH of preserved samples shall be checked in the field by pouring a small amount of the water sample onto pH paper. The paper shall not touch the sample inside the container. Do not check the pH of acidified VOC samples. The preservation checks shall be documented in the chain-of-custody forms. One preserved VOC sample per day per sampling crew shall be checked with pH paper. The sole purpose of this sample is to check the pH of VOC samples, it shall not be submitted for analysis.

Required sample containers, preservation methods, volumes and holding times are given in Section 6.2 and Table 6.2.2-1. Sampling equipment shall be decontaminated in accordance with Section 5.12 upon completion of sampling activities.

6.1.1.2 Direct Push Sampling

Direct push sampling involves advancing a sampling probe to the point below the water table from which the sample is desired. The probe can be advanced by direct hydraulic pressure or by using a slide or rotary hammer. When the probe is at the proper depth, sampling ports on the probe are opened, and the sample is collected

using a bailer, by vacuum pressure or using the natural pressure of the formation. Samples collected for VOC analysis shall not be drawn by vacuum pressure. The advantage of this method is no drill cuttings are produced.

HydroPunch® and cone penetrometer samples are generally collected for on-site or quick-turnaround analysis to determine if the boring should be converted to a monitor well or to fill data gaps. These samples are not directly comparable to monitor well samples, because they are collected from disturbed conditions. HydroPunch® sampling is performed during drilling when the boring extends below the water table. With this method, a 2-inch diameter core is obtained by advancing a core sampler into the unconsolidated formation 3-5 feet below the water table using direct hydraulic pressure or a hydraulic hammer. The core is then retrieved, leaving a small borehole. The borehole is then completed as a temporary monitor well that can be sampled with a 1-inch diameter bailer or peristaltic pump, depending on depth. The temporary monitor well shall be sampled with a 1-inch diameter bailer.

6.1.2 Subsurface Soil Sampling

Soil samples shall be collected based on odors, discoloration, organic vapor meter readings and any other field screening method.

6.1.2.1 Split-Spoon Samples

When soil samples are to be submitted for laboratory analysis, they shall be collected using stainless steel, continuous drive, California modified split-spoon samplers, or equivalent. These samplers are 24 inches in length and have an outside diameter (OD) of 3 inches to accommodate four 2-inch diameter brass/stainless steel rings, each of which is 6 inches in length.

Each time a split-spoon sample is taken, a standard penetration test shall be performed in accordance with ASTM D-1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." The sample is obtained by driving the sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. The sampler is first driven 6 inches to seat it in undisturbed soil; then the test is performed. The number of hammer blows for seating the spoon and making the test are then recorded for each 6 inches of penetration on the drill log (i.e., 5/7/8). The standard penetration test result (N) is obtained by adding the last two figures (i.e., 7+8=15 blows per foot). The sampler is then driven an additional 6 inches to fill the remainder of the split-spoon prior to retrieval.

As soon as the split-spoon is opened, the open ends of the brass/stainless steel rings shall be monitored for organic vapors using the PID or FID. Air monitor results shall be recorded on the boring log and in the field log book.

Samples for VOC analysis shall be collected as an entire brass/stainless steel ring sample. Brass/stainless steel rings selected for VOC analysis shall be completely filled, if possible, to minimize headspace. Rings with large gravel or debris shall not be used. Following monitoring for organic vapors, the brass/stainless steel rings shall be capped on both ends with Teflon sheeting and plastic end caps to prevent volatilization. The brass/stainless steel rings shall then be affixed with a completed sample label, placed in a zip lock plastic bag and placed in an iced cooler held at a temperature below 4° C.

Samples collected concurrently with VOC samples to be tested for other analytical parameters shall be collected by extruding the soil out of the brass/stainless steel rings immediately adjacent to (above and below) the VOC sample interval. Soil chemistry samples not being analyzed for VOCs shall be placed in 8 or 16-ounce, laboratory cleaned, EPA-approved glass containers with Teflon lined lids. This shall be done using clean stainless steel sampling tools. If soil from several brass/stainless steel rings must be composited to provide sufficient sample volume for a particular analysis, the sample shall be composited and homogenized in a stainless steel bowl using a stainless steel trowel or scoop. The sample shall then be transferred into the appropriate sample container, sealed, labeled, and place in an iced cooler held at a temperature below 4° C.

If initial screening results indicate the presence of organic vapors, a headspace analysis shall be conducted on remaining portions of the sample.

6.1.2.2 Sampling by Hand Auger

Hand auguring is used to collect soil samples from depths up to 10 feet bgs, although the technique can sometimes be used to a depth as great as 30 feet bgs. This method is not appropriate for collecting samples for volatile organics analysis, because volatile compounds may be lost.

Each hand auger boring shall be advanced by manually turning a hand auger, equipped with 3-inch diameter cylindrical stainless steel bits, until the auger head fills with cuttings. The hand auger is then pulled from the boring and the cuttings shall be deposited on plastic sheeting. The hand auguring is continued until the sampling depth is achieved.

At the predetermined sampling depth, a manually powered hammer is used to drive a sampler. The sampler is driven into the bottom of the boring to a depth of 6 inches, or until refusal. The sampler is then retrieved and the recovery is determined by estimating the percentage of the sample in the brass/stainless steel sleeve. The sample lithology is then described and recorded on the boring log.

The brass/stainless steel sleeve shall be capped with Teflon™ tape and end caps. The ends of the capped sleeve shall then also be wrapped with Teflon™ tape. Care shall be taken not to touch the ends of the sleeves prior to capping. Custody seals shall be placed across the capped ends of the sleeve. Once the container has been filled, the appropriate information shall be recorded in the field logbook.

6.1.2.3 Direct Push Sampling

Direct push sampling involves advancing a sampling probe by direct hydraulic pressure or by using a slide or rotary hammer. Samples may be collected continuously or at specific depths. The samples are collected in brass/stainless steel sleeves. The sleeve shall be capped with Teflon™ tape and end caps. The ends of the capped sleeve shall then also be wrapped with Teflon™ tape. Care shall be taken not to touch the ends of the sleeves prior to capping. Custody seals shall be placed across the capped ends of the sleeve. Once the container has been filled, *the containers will be labeled and* the appropriate information shall be recorded in the field logbook.

For the basewide background study, samples will be collected from the 0- to 2.0-foot depth interval and from the 6.0- to 8.0-foot (approximate) depth interval. Each interval will be sampled using a 2-foot-long, 2-inch-diameter stainless steel drive sampler lined with four 6-inch stainless steel sleeves. The second sleeve from each sample (the 0.5- to 1.0-foot interval, in the case of the surface sample) will be handled as described in the previous paragraph, and submitted for analysis for volatile organic compounds. The remaining three sleeves will be composited and analyzed for semivolatile and metal compounds.

A core from the 2.0- to 6.0-foot interval shall be collected in a 4-foot plastic sleeve to complete the lithologic description and confirm that the transition between the shallow, dark, organic soil horizon and the deeper, less organic soil occurs as anticipated in this interval.

Samples will be collected in a similar fashion at the WSA, except that all four sleeves will be composited and submitted for analysis for radionuclides and TEPH.

6.1.3 Surface Soil Sampling

Surface soil samples shall be collected from the land surface to six inches below the surface. The sample shall be homogenized and quartered before being containerized. If chemicals that are highly adsorbed to clay surfaces were released at the site, an additional sample shall be collected from the surface to the 1 inch depth.

Stainless steel scoops or trowels, glass jars with Teflon lids or equivalent equipment compatible with the chemical analyses proposed shall be used to collect and store samples. Exclude above ground plant parts and debris from the sample.

In addition to records outlined in Section 8.0, record unusual surface conditions that may affect the chemical analyses, such as the following: (1) asphalt chunks that may have been shattered by mowers, thus spreading small fragments of asphalt over the sampling area, (2) distance to roadways, aircraft runways, or taxiways, (3) obvious, deposition of contaminated or clean soil at the site, (4) evidence of dumping or spillage of chemicals, (5) soil discoloration, and/or (6) unusual condition of growing plants, etc.

6.1.4 Surface Water Sampling

Collect samples so as not to cause cross-contamination. If collecting both water and sediment samples at a specific location, always obtain the water sample first. Measure and record pH, temperature, specific conductance, and dissolved oxygen (when required) at each surface water sampling point. Permanently mark the location where surface water or sediment samples are collected (e.g., flagged stake in stream bank). Record the location on a project map for each specific site or zone.

The sample collection sequence is as follows: (1) if sampling both water and sediment or just sediment, start at the most downstream point and proceed upstream, (2) if sampling water only and the sample can be taken without disturbing the river or stream bottom, obtain any background samples first, then the farthest downstream sample, and then move upstream toward the source or discharge point, (3) if sampling water only and the stream or river bottom must be disturbed, start at the most downstream point and proceed upstream.

Samples shall be taken from the active portion of the stream on the side nearest the source of contamination or suspected plume. Water samples are collected using a Van Dorn Sampler or Kemmerer Sampler when grab samples are required, or using an autosampler (discrete or composite samples) with the inlet line located at the desired sampling depth. Samples from multiple locations are combined in a decontaminated bucket (nonvolatile samples only) and aliquots are taken for composite samples.

Surface water samples may also be obtained using a continuous automatic sampler. With a continuous sampler, an intake probe is secured at the sampling point and the sampler is pre-programmed to collect either individual or composite samples at designated times throughout the day.

The following records shall be maintained in addition to those in Section 8.0, (1) the width, depth, and flow rate of streams, (2) surface water conditions (e.g., floating oil or debris, gassing), (3) the location of any discharge pipes, sewers, or tributaries, and (4) instrument calibration.

6.1.5 Sediment Sampling

Sediment samples are collected from ponds, surface impoundments, and streambeds (both wet and dry). Sediment samples shall be collected using a polyvinyl chloride (PVC) tube or dredge (Ponar, Peterson, or Ekman) when water is present. Each technique allows for the collection of discrete samples, with the option of compositing samples in either the field or the laboratory. Dry sediment samples may be collected by surface scraping, hand auguring, or core sampling using a core sampler with stainless-steel sleeves. Methods for dry sediment sampling are the same as that for soil. Sediment samples may be collected near discharge points in areas where sediment has accumulated inside an edge of a bend, an area where a stream suddenly widens, etc. The order of sample collection shall be the same as that described for surface water samples.

6.1.6 Soil Gas Sampling

Not applicable.

6.1.7 Indoor Air Sampling

Not applicable.

6.2 SAMPLE HANDLING

6.2.1 Sample Containers

Sample containers are purchased precleaned and treated according to EPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the EPA-recommended procedures (i.e., EPA 540/R-93/051). Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

6.2.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in Table 6.2.2-1.

Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely for AFCEE work are specified in Table 6.2.2-1. **Samples not preserved or analyzed in accordance with these requirements shall be resampled and analyzed, at no additional cost to AFCEE.**

Table 6.2.2-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container ^a	Preservation ^{b,c}	Minimum Sample Volume or Weight	Maximum Holding Time
Alkalinity	E310.1	P, G	4° C	50 mL	14 days
Common anions	SW9056	P, G	None required	50 mL	28 days for Br ⁻ , F ⁻ , Cl ⁻ , and SO ₄ ⁻² ; 48 hours for NO ₃ ⁻ , NO ₂ ⁻ , and PO ₄ ⁻³
Cyanide, total and amenable to chlorination	SW9010A SW9012	P, G, T	4° C; NaOH to pH > 12, 0.6 g ascorbic acid	500 mL or 4 ounces	14 days (water and soil)
Filterable residue	E160.1	P, G	4° C	100 mL	7 days
Nonfilterable residue	E160.2	P, G	4° C	100 mL	7 days
Hydrogen ion (pH) (W, S)	SW9040/ SW9045	P, G	None required	N/A	Analyze immediately
Nitrogen, nitrate+nitrite	E353.1	P, G	4° C, H ₂ SO ₄ to pH < 2	500 mL	28 days
Conductance	SW9050	P, G	None required	N/A	Analyze immediately
Temperature	E170.1	P, G	None required	N/A	Analyze immediately
Dissolved oxygen	E360.1	G	None required	500 mL	Analyze immediately
Turbidity	E180.1	P, G	4° C	N/A	48 hours
Total organic carbon	SW9060	P, G, T	4° C, HCl or H ₂ SO ₄ to pH < 2	500 mL or 4 ounces	28 days (water and soil)
Chromium (VI)	SW7196A	P, G, T	4° C	500 mL or 8 ounces	24 hours (water and soil) ^d
Mercury	SW7470 SW7471	P, G, T	HNO ₃ to pH < 2, 4° C	500 mL or 8 ounces	28 days (water and soil)
Metals (except chromium (VI) and mercury)	SW6010A SW6020 and SW-846 AA methods	P, G, T	HNO ₃ to pH < 2, 4° C	500 mL or 8 ounces	180 days (water and soil)
Total petroleum hydrocarbons (TPH)-volatile	SW8015 (modified)	G, Teflon-lined septum, T	4° C, HCl to pH < 2	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Total petroleum hydrocarbons (TPH)-extractable	SW8015 (modified)	G, amber, T	4° C	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)

Name	Analytical Methods	Container ^a	Preservation ^{b,c}	Minimum Sample Volume or Weight	Maximum Holding Time
Volatile aromatics	SW8020A	G, Teflon-lined septum, T	4° C, HCl to pH < 2, 0.008% Na ₂ S ₂ O ₃	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Halogenated volatiles	SW8021A	G, Teflon-lined septum, T	4° C, HCl to pH < 2, 0.008% Na ₂ S ₂ O ₃	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Nitrosamines	SW8070	G, Teflon-lined cap, T	4° C	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Chlorinated herbicides	SW8150B SW8151	G, Teflon-lined cap, T	4° C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organochlorine pesticides and polychlorinated biphenyls (PCBs)	SW8080A, SW8081,	G, Teflon-lined cap, T	4° C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organophosphorus pesticides/ compounds	SW8140 SW8141A	G, Teflon-lined cap, T	4° C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Semivolatile organics	SW8270B	G, Teflon-lined cap, T	4° C, 0.008% Na ₂ S ₂ O ₃	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Volatile organics	SW8240B, SW8010B, SW8260A	G, Teflon-lined septum, T	4° C, 0.008% Na ₂ S ₂ O ₃ (HCl to pH < 2 for volatile aromatics by SW8240 and SW8260) ^b	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid

Name	Analytical Methods	Container ^a	Preservation ^{b,c}	Minimum Sample Volume or Weight	Maximum Holding Time
Polynuclear aromatic hydrocarbons (PAHs)	SW8310	G, Teflon-lined cap, T	4° C, store in dark, 0.008% Na ₂ S ₂ O ₃	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Dioxins and furans	SW8280	G, Teflon-lined cap, T	4° C, 0.008% Na ₂ S ₂ O ₃	1 liter or 8 ounces	30 days until extraction and 45 days after extraction (water and soil)
Ethylene dibromide (EDB)	SW8011	G, Teflon-lined cap, T	4° C, 0.008% Na ₂ S ₂ O ₃	2 x 40 mL	28 days (water)
Explosive residues	SW8330	P, G, T	Cool, 4° C	1 liter or 8 ounces	7 days to extraction (water); 14 days to extraction (soil); analyze within 40 days after extraction
TCLP	SW1311	G, Teflon-lined cap, T	Cool, 4° C	1 liter or 8 ounces	14 days to TCLP extraction and 14 days after extraction (volatiles); 14 days to TCLP extraction and 40 days after extraction (semivolatiles); 28 days to TCLP extraction and 28 days after extraction (mercury); 180 days to TCLP extraction and 180 days after extraction (metals)
Total recoverable petroleum hydrocarbons	E418.1	G, Teflon-lined cap, T	4° C, H ₂ SO ₄ to pH < 2	1 liter or 8 ounces	28 days (water); 14 days until extraction and 40 days after extraction (soil)

Notes:

- a. Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T).
- b. No pH adjustment for soil.
- c. Preservation with 0.008 percent Na₂S₂O₃ is only required when residual chlorine is present.
- d. The maximum recommended holding time for completion of extraction into water is 48 hours. The extract shall be analyzed within 24 hours of completion of extraction.

6.2.3 Sample Identification

Each sample collected will be assigned a unique sample identification number. Sample containers will be labeled with the sample number and will be entered on the chain-of-custody (COC) form. To eliminate any bias by the laboratory, the relationship between the unique sample identification number and the actual field sample number will be known only to Jacobs.

6.3 SAMPLE CUSTODY

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

The contractor shall maintain chain-of-custody records for all field and field Quality Control (QC) samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view, after being in their possession, (3) it was in their possession and they locked it up or, (4) it is in a designated secure area.

All sample containers shall be sealed in a manner that shall prevent or detect tampering if it occurs. In no case shall tape be used to seal sample containers. Samples shall not be packaged with activated carbon unless prior approval is obtained from the AFCEE.

The following minimum information concerning the sample shall be documented on the AFCEE chain of custody (COC) form (as illustrated in Section 8):

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of MS/MSD
- Preservative used
- Analyses required
- Name of collector(s)
- Pertinent field data (pH, temperature, etc.)
- Serial numbers of custody seals and transportation cases (if used)

- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection in accordance with IAW Section 6.2.3 of the FSP.

Samples collected in the field shall be transported to the laboratory or field testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank (a volatile organics compounds sampling vial filled with water) shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory.

6.4 FIELD QUALITY CONTROL SAMPLES

6.4.1 Ambient Blank

The ambient blank consists of ASTM Type II reagent grade water poured into a volatile organic compound (VOC) sample vial at the sampling site. It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection. Ambient blanks shall be collected downwind of possible VOC sources. The frequency of collection for ambient blanks is specified in Section 3.2.

6.4.2 Equipment Blank

An equipment blank is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. The frequency of collection for equipment blanks is specified in Section 3.2. Equipment blanks shall be collected immediately after the equipment has been decontaminated. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

6.4.3 Trip Blank

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank shall accompany each cooler of samples sent to the laboratory for analysis of VOCs.

6.4.4 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest. The frequency of collection for field duplicates is specified in Section 3.2.

6.4.5 Field Replicates

A field replicate sample, also called a split, is a single sample divided into two equal parts for analysis. The sample containers are assigned an identification number in the field such that they cannot be identified as replicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field replicate samples prior to the beginning of sample collection. Replicate sample results are used to assess precision. The frequency of collection for field replicates is specified in Section 3.2.

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7.0 FIELD MEASUREMENTS

The following sections discuss the field measurements that will be performed during the field investigation. Field measurement equipment, equipment calibration, and equipment maintenance are also described.

7.1 PARAMETERS

The following field measurements will be made during sampling and recorded in field logbooks or on forms.

Organic Vapor Analysis. *During drilling operations and each time a well casing cap is removed, the air in the breathing zone and within the well bore will be checked with an HNu photoionization detector for organic vapors. If organic vapors are detected, procedures provided in the HSP will be followed.*

Metal Detector. *Metal detector surveys may be performed as a final check for buried utilities or other foreign materials before starting any ground intrusive activities.*

Water-Level Measurement. *The groundwater level will be measured to within 0.01 foot in monitoring wells, well points, and augers where groundwater samples are collected. The total depth of each monitoring well, well point, and borehole will also be measured.*

Immiscible Layer Measurement. *Groundwater that is sampled through augers, monitoring wells, and well points will be monitored for immiscible layers using an interface probe. Depths and thicknesses will be measured to within 0.01 foot.*

Conductivity, pH, Temperature, Dissolved Oxygen, and Turbidity. *These water quality parameters will be measured using a single instrument during monitoring well development, well purging, and well sampling, as well as during surface water sampling.*

7.2 EQUIPMENT CALIBRATION AND QUALITY CONTROL

To meet data quality objectives, proper calibration procedures for field equipment will be followed as described in the manufacturer's instrument manuals and the IRP Handbook.

7.2.1 Calibration Frequencies

Daily, and in some cases more frequent, calibration of equipment will provide QA checks on all equipment used during implementation of the 1996 field investigation. Each instrument will have an individual identification number affixed. This number

will be transcribed on field data records when using a particular instrument for a sampling event. All calibration, repair, and service records will be kept in individual equipment logbooks that will be maintained for each type of instrument. Equipment that consistently falls out of calibration or exceeds manufacturer's critical limits will be appropriately repaired or replaced.

7.2.2 Calibration Procedures

Photoionization Detector. These instruments require calibration at least daily. The PID instruments are calibrated using commercially available gases of known concentrations. Calibration will be performed according to the manufacturer's recommendations and will be recorded in the appropriate equipment logbook. Routine maintenance consists of battery charging to ensure that the instrument is ready to use when required and occasional lamp or fan cleaning.

Electronic Water-Level Meter. The audible tone is checked by immersing the probe in water. The tape is calibrated annually by using a surveyor's steel tape to adjust for stretching of the calibrated line.

Interface Probe. The audible tones are checked by immersing the probe in water and oil. The tape is calibrated annually by using a surveyor's steel tape to adjust for stretching of the calibrated line.

Electrical Conductivity, pH, Temperature, Dissolved Oxygen, and Turbidity Meter. A single instrument will be used to measure all six of these parameters. This instrument will be calibrated at each surface water or groundwater sampling location and during well development. It may be calibrated either manually or automatically using a four-parameter auto-calibration solution.

The electrical conductivity function will be calibrated using a standard solution that is numerically similar to the expected range of conductivities at NAS Fort Worth.

The dissolved oxygen function will be calibrated against ambient air.

The turbidity function will be checked using a standard within the expected range of sample turbidities. The temperature function is self-calibrating on this instrument.

7.2.3 Control Parameters

Several parameters will be controlled during the field operations, sampling, and measurement activities. Calibration of field instruments and operational checks will be conducted periodically. The frequency of the field control check duplicates will be a minimum of 10 percent of all field measurements. Measurements for temperature,

pH, and specific conductance will be checked at this frequency. As applicable, the materials used to verify the measurements will be from certified sources.

Onsite laboratory instrumentation, if used, will be controlled according to the method specifications and laboratory standard operating procedures. These controls will include the analysis of calibration standards, method blanks, field QC samples (trip blanks, equipment blanks, field duplicates, and replicates), reference standards, and matrix spike samples. Before sample analyses, the instrument will be verified for proper installation and operation. This procedure will include, but is not limited to, verification of purge-rate stability, system leak testing, and overall detector response.

7.2.4 Control Limits

Duplicate temperature and specific conductance measurements will be considered suspect when a percent difference of greater than 25 percent is observed. For the pH measurements, field readings that vary more than 0.1 standard units will be considered suspect.

These limits are based on the data quality needs required to support well placement and sampling decisions.

7.2.5 Corrective Actions

The corrective action required for field instruments used to measure temperature, pH, and conductivity will include recalibrating and remeasuring the parameter.

7.3 EQUIPMENT MAINTENANCE AND DECONTAMINATION

Field measurement equipment will be maintained according to the manufacturer's recommended procedures provided in the operations manual for each instrument.

On a routine basis, instrument electrodes will be inspected for scratches, cracks, salt crystal buildup, and membrane/junction deposits. Probes will be cleaned with nonphosphate detergent and water or with a weak solution of hydrochloric acid. After acid soaking, electrodes will be thoroughly rinsed with deionized water.

Field measurement equipment will be kept free of contamination. Instruments, such as the water level indicator, that contact water to be sampled will be decontaminated following the procedures for sampling equipment described in Section 5.12. Instruments that are sensitive to soap and solvents, like the combination pH meter, will be rinsed with potable water and ASTM Type II reagent-grade water. The probes will be cleaned daily and stored overnight according to the manufacturer's recommended procedures.

7.4 FIELD MONITORING MEASUREMENTS

7.4.1 Groundwater Level Measurements

Water-level measurements shall be taken in all wells and piezometers to determine the elevation of the water table or piezometric surface at least once within a single 24-hour period. These measurements shall be taken after all wells and piezometers have been installed and developed and their water levels have recovered completely. Any conditions that may affect water levels shall be recorded in the field log.

Water-level measurements shall be taken with electric sounders, air lines, pressure transducers, or water-level recorders (e.g., Stevens recorder). Devices that may alter sample composition shall not be used. Pressure gauges, manometers, or equivalent devices shall be used for flowing wells to measure the elevation of the piezometric surface. All measuring equipment shall be decontaminated according to the specifications in Section 7.3 and 5.12. Groundwater level shall be measured to the nearest 0.01 foot.

Static water levels shall be measured each time a well is sampled, and before any equipment enters the well. If the casing cap is airtight, allow time prior to measurement for equilibration of pressures after the cap is removed. Repeat measurements until water level is stabilized.

7.4.2 Floating Hydrocarbon Measurements

The thickness of hydrocarbons floating in monitor wells shall be measured with an electronic interface probe. Hydrocarbon detection paste, or any other method that may affect water chemistry, shall not be used. When detected, the presence of floating hydrocarbons shall be confirmed by withdrawing a sample with a clear, bottom-fill Teflon bailer.

7.4.3 Groundwater Discharge Measurements

Groundwater discharge measurements shall be obtained during monitor well purging and aquifer testing. Groundwater discharges may be measured with orifice meters, containers of known volume, in-line meters, flumes, or Weirs, following the guidelines specified in the *Water Measurement Manual*, Bureau of Reclamation, 1967. If discharge measuring devices are upstream of sample collection points, the devices shall be decontaminated. Measurement devices shall be calibrated using containers of known volume.

7.5 FIELD PERFORMANCE AND SYSTEM AUDITS

Performance and system audits for sampling and analysis may be conducted. Audits may include a review of field and laboratory QA systems and onsite review of equipment for sampling calibration and measurement. Audits may evaluate the capability and performance of project personnel, items, activities, and documentation. The audits will ensure and document that QC measures are being used to provide data of acceptable quality, and that subsequent calculations, interpretation, and other project outputs are checked and validated. Scheduled and unscheduled audits will be conducted. System and performance audits may be conducted by the Jacobs QA Officer or his designee. The QA Officer or designee will audit fieldwork and review the project documentation. The laboratory field QA Officer will perform systems, methods, and performance audits in accordance with the Laboratory Quality Assurance Plan (LQAP) and this QAPP.

During a systems audit, the entire QA process is evaluated. The project or field team organization is reviewed for compliance with the proposed organization and for clarity of assigned responsibility. Personnel assigned to the project will be evaluated to make certain that assigned responsibility, skill, and training are properly matched.

A systems audit may be conducted on all components of measurement systems to determine proper selection and use. The systems audit includes evaluation of both field and laboratory procedures.

During a performance audit, proper execution of SOPs or QC procedures are evaluated. The audit will address whether field equipment and analytical instruments are selected and used to meet requirements specified by the project objectives stated in the QAPP. Equipment and facilities provided for personnel health and safety may also be evaluated. Calibration procedures for field instruments will also be covered.

A review of analytical methodology with respect to data requirements for the project will be performed. An onsite observation of analytical technique, data reduction and record keeping may be performed, if necessary.

QA audits are conducted at the request of project management or the Air Force. A written report of a QA project audit will include the following:

- an assessment of project team status in each major project area;*
- clear statements of areas requiring improvement or problems to be corrected;*
- recommendations and assistance regarding proposed corrective actions or system improvements; and*
- a timetable for any corrective action required.*

8.0 RECORD KEEPING

The contractor shall maintain field records sufficient to recreate all sampling and measurement activities and to meet all IRP Information Management Systems (IRPIMS) data loading requirements. The requirements listed in this section apply to all measuring and sampling activities. Requirements specific to individual activities are listed in the section that addresses each activity. The information shall be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. These records shall be archived in an easily accessible form and made available to the Air Force upon request.

The following information shall be recorded for all field activities: (1) location, (2) date and time, (3) identity of people performing activity, and (4) weather conditions. For field measurements: (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument, shall also be recorded.

The following additional information shall be recorded for all sampling activities: (1) sample type and sampling method, (2) the identity of each sample and depth(s), where applicable, from which it was collected, (3) the amount of each sample, (4) sample description (e.g., color, odor, clarity), (5) identification of sampling devices, and (6) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing).

The following pages are copies of ACFEE-approved forms for this project.

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AFCEE APPROVED FORMS

BORING LOG

Borehole ID: _____
 Sheet _____ of _____

					Location				
Project Name		Project Number		LTCCODE (IRPIMS)		Site ID	LPRCODE (IRPIMS)		
Drilling Company		Driller		Ground Elevation		Total Drilled Depth			
Drilling Equipment	Drilling Method	Borehole Diameter	Date/Time Drilling Started		Date/Time Total Depth Reached				
Type of Sampling Device				Water Level (bgs)					
				First		Final			
Sample Hammer				Hydrogeologist		Checked by/Date			
Type	Driving Wt.	Drop							
Location Description (include sketch in field logbook)									
Depth	Interval	Recovery	Blow Counts	Description <small>(Include lithology, grain size, sorting, angularity, Munsell color name & notation, mineralogy, bedding, plasticity, density, consistency, etc., as applicable)</small>		USCS Symbol	Lithology	Water Content	Remarks <small>(Include all sample types & depth, odor, organic vapor measurements, etc.)</small>

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID _____
SHEET _____ of _____

PROJECT NAME: _____ PROJECT NO.: _____ DATE: _____

LOCATION: _____ DATE INSTALLED: _____

TOTAL DEPTH (FTOC) _____ CASING DIAMETER _____

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☐ Pumping ☐ Describe _____
 Equipment decontaminated prior to development ☐ Yes ☐ NO
 Describe _____

EQUIPMENT NUMBERS:

pH Meter _____ EC Meter _____ Turbidity Meter _____ Thermometer _____

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

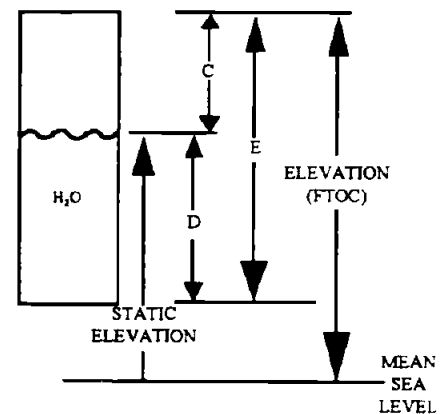
Measured Well Depth (B) _____ ft

Measured Water Level Depth (C) _____ ft

Length of Static Water Column (D) _____ - _____ = _____ ft
(B) (C)

Casing Water Volume (E) + _____ x _____ = _____ gal
(A) (D)

Total Purge Volume = _____ (gal)



Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	EC	Temperature F or C	Turbidity/ Sand (ppm)	Comments

Page ____ of ____

LOCATION _____ SLUG VOLUME (FT³) _____

LOCATION I.D. _____ LOGGER CODE _____

LOGDATE _____ ACCEPTANCE CODE _____

TEST METHOD: _____

COMMENTS: _____

[illegible][illegible]

ACCEPTANCE CODES: A - ACCEPTABLE R - RECONNAISSANCE U - UNACCEPTABLE N - NOT DETERMINED

FORM COMPLETED BY / DATE

TECHNICAL REVIEWER / DATE

WASTE INVENTORY TRACKING FORM

LOCATION : _____

PROJECT NAME: _____

ACTIVITIES: _____

Date Waste Generated	Activity Generating Waste (borehole # / well #)	Description of Waste	Field Evidence of Contamination	Estimated Volume	Type of Container (storage ID#)	Location of Container	Waste Characterization	Comments

Note: Describe whether soil or water samples have been collected for waste characterization, include date, if known.

Signature: _____

SLUG TEST DATA FORM

Page ____ of ____

SLUG TEST DATA

LOCATION _____ SLUG VOLUME (FT³) _____

LOCATION I.D. _____ LOGGER CODE _____

LOGDATE _____ ACCEPTANCE CODE _____

TEST METHOD: ☐ SLUG INJECTION OR ☐ SLUG WITHDRAWAL

COMMENTS: _____

ELAPSED TIME (MIN)	DEPTH-TO-WATER (FT)
0.00	

ELAPSED TIME (MIN)	DEPTH-TO-WATER (FT)

ACCEPTANCE CODES: A - ACCEPTABLE R - RECONNAISSANCE U - UNACCEPTABLE N - NOT DETERMINED

FORM COMPLETED BY / DATE

TECHNICAL REVIEWER / DATE

MONITOR WELL STATIC WATER LEVEL FORM

PROJECT NAME: _____ DATE: _____

WATER LEVEL INDICATOR ID # _____ FIELD BOOK # _____

LOCATION: _____ PAGE # _____

Monitor Well Number	Time	Depth to Static Water Level (from T.O.C.)	Total Well Depth (ft)	Explosimeter Reading (above background)	PID Reading (above background)

Note: Total well depth to be measured at time of gauging.

Comments: _____

Sampler _____ Observer _____

姓名: 王德胜
 性别: 男
 年龄: 45岁
 职业: 教师
 籍贯: 湖南长沙
 民族: 汉族
 婚姻状况: 已婚
 子女情况: 一子一女
 健康状况: 良好
 兴趣爱好: 读书、运动
 特长技能: 教学、写作
 工作经历: 在中学任教十年
 教育程度: 大学本科
 语言能力: 普通话流利
 其他信息: 无不良嗜好

DATE: _____

EXPLOSIMETER BOREHOLE READING _____

PURGE VOLUME
(3 WELLBORE VOLUMES): _____ (gal)

WELL DEPTH: _____

[illegible]

Note: Condition of the well: _____

pH - Calibrate at start and before last reading.

Sampler _____ Observer _____

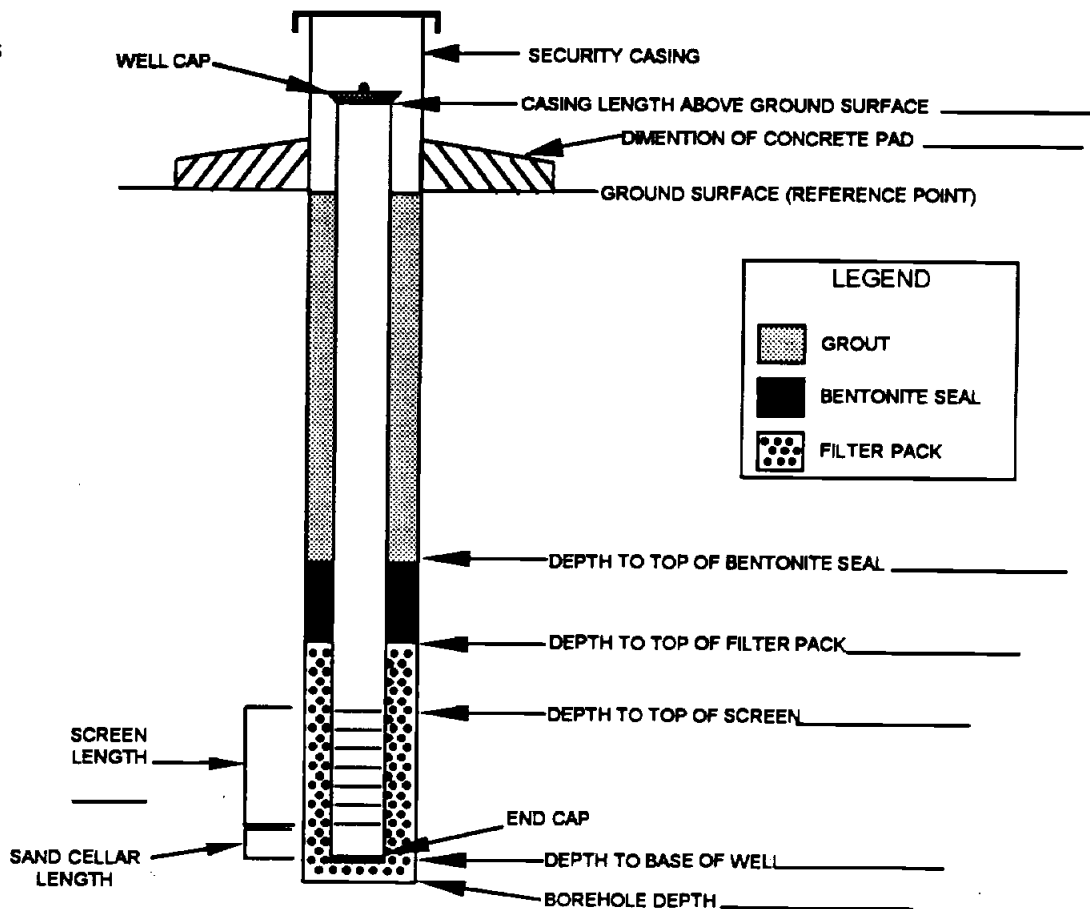
FIELD SAMPLING REPORT

LOCATION: _____		PROJECT: _____	
SITE: _____			
SAMPLE INFORMATION			
MATRIX _____		SAMPLE ID: _____	
SAMPLING METHOD _____		DUP./REP. OF: _____	
BEGINNING DEPTH _____		MATRIX SPIKE/MATRIX SPIKE DUPLICATE YES () NO ()	
END DEPTH _____			
GRAB () COMPOSITE ()		DATE: _____ TIME: _____	
CONTAINER		PRESERVATIVE/ PREPARATION	EXTRACTION METHOD
SIZE/TYPE	#		ANALYTICAL METHOD
			ANALYSIS
NOTABLE OBSERVATIONS			
PID READINGS		SAMPLE CHARACTERISTICS	MISCELLANEOUS
1st		COLOR:	
2nd		ODOR:	
		OTHER:	
GENERAL INFORMATION			
WEATHER: SUN/CLEAR _____ OVERCAST/RAIN _____ WIND DIRECTION _____ AMBIENT TEMP _____			
SHIPMENT VIA: FED-X _____ HAND DELIVER _____ COURIER _____ OTHER _____			
SHIPPED TO: _____			
COMMENTS: _____			
SAMPLER: _____		OBSERVER: _____	
MATRIX TYPE CODES		SAMPLING METHOD CODES	
DC=DRILL CUTTINGS	SL=SLUDGE	B=BAILER	G=GRAB
WG=GROUND WATER	SO=SOIL	BR=BRASS RING	HA=HAND AUGER
LH=HAZARDOUS LIQUID WASTE	GS=SOIL GAS	CS=COMPOSITE SAMPLE	H=HOLLOW STEM AUGER
SH=HAZARDOUS SOLID WASTE	WS=SURFACE WATER	C=CONTINUOUS FLIGHT AUGER	HP=HYDRO PUNCH
SE=SEDIMENT	SW=SWAB/WIPE	DT=DRIVEN TUBE	SS=SPLIT SPOON
		W=SWAB/WIPE	SP=SUBMERSIBLE PUMP

WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: _____ TYPE OF FILTER PACK: _____
 GRADATION: _____
 DRILLING CONTRACTOR: _____ AMOUNT OF FILTER PACK USED: _____
 DRILLING TECHNIQUE: _____ TYPE OF BENTONITE: _____
 AUGER SIZE AND TYPE: _____ AMOUNT BENTONITE USED: _____
 BOREHOLE IDENTIFICATION: _____ TYPE OF CEMENT: _____
 BOREHOLE DIAMETER: _____ AMOUNT CEMENT USED: _____
 WELL IDENTIFICATION: _____ GROUT MATERIALS USED: _____
 WELL CONSTRUCTION START DATE: _____
 WELL CONSTRUCTION COMPLETE DATE: _____ DIMENSIONS OF SECURITY CASING: _____
 SCREEN MATERIAL: _____ TYPE OF WELL CAP: _____
 SCREEN DIAMETER: _____ TYPE OF END CAP: _____
 STRATUM-SCREENED INTERVAL (FT): _____
 COMMENTS: _____
 CASING MATERIAL: _____
 CASING DIAMETER: _____

SPECIAL CONDITIONS
(describe and draw)



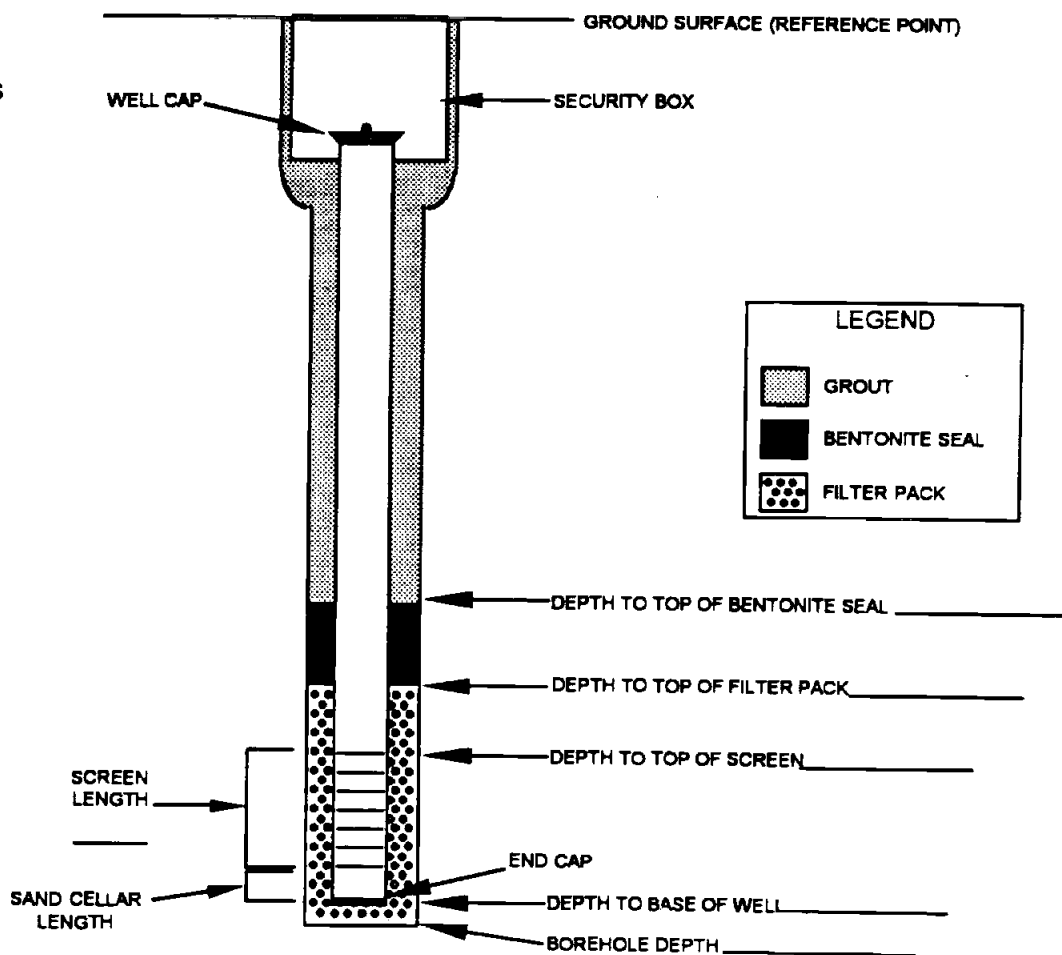
NOT TO SCALE

INSTALLED BY: _____ INSTALLATION OBSERVED BY: _____
 DISCREPANCIES: _____

WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: _____	TYPE OF FILTER PACK: _____
DRILLING CONTRACTOR: _____	GRADIATION: _____
DRILLING TECHNIQUE: _____	AMOUNT OF FILTER PACK USED: _____
AUGER SIZE AND TYPE: _____	TYPE OF BENTONITE: _____
	AMOUNT BENTONITE USED: _____
BOREHOLE IDENTIFICATION: _____	TYPE OF CEMENT: _____
BOREHOLE DIAMETER: _____	AMOUNT CEMENT USED: _____
WELL IDENTIFICATION: _____	GROUT MATERIALS USED: _____
WELL CONSTRUCTION START DATE: _____	
WELL CONSTRUCTION COMPLETE DATE: _____	DIMENSIONS OF SECURITY BOX: _____
SCREEN MATERIAL: _____	TYPE OF WELL CAP: _____
SCREEN DIAMETER: _____	TYPE OF END CAP: _____
STRATUM-SCREENED INTERVAL (FT): _____	
CASING MATERIAL: _____	COMMENTS: _____
CASING DIAMETER: _____	

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: _____ INSTALLATION OBSERVED BY: _____

DISCREPANCIES: _____

FINAL PAGE

ADMINISTRATIVE RECORD

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